



# Full wwPDB NMR Structure Validation Report ⓘ

Apr 27, 2016 – 04:46 AM BST

PDB ID : 2RLI  
Title : Solution structure of Cu(I) human Sco2  
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Deposited on : 2007-07-11

This is a Full wwPDB NMR Structure Validation Report for a publicly released PDB entry.  
We welcome your comments at [validation@mail.wwpdb.org](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

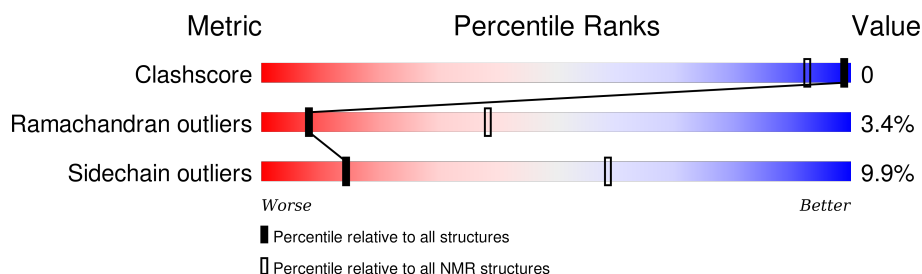
# 1 Overall quality at a glance

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	171	

## 2 Ensemble composition and analysis

This entry contains 31 models. Model 3 is the overall representative, medoid model (most similar to other models). The authors have identified model 1 as representative, based on the following criterion: *minimized average structure*.

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:103-A:210, A:222-A:261 (148)	0.97	3

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 5 clusters and 12 single-model clusters were found.

Cluster number	Models
1	5, 6, 12, 13, 20, 23, 29
2	3, 4, 7, 11, 14
3	10, 15, 18
4	1, 27
5	9, 31
Single-model clusters	2; 8; 16; 17; 19; 21; 22; 24; 25; 26; 28; 30

### 3 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 2677 atoms, of which 1306 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called SCO2 protein homolog, mitochondrial.

Mol	Chain	Residues	Atoms						Trace
1	A	170	Total	C	H	N	O	S	0
			2676	864	1306	243	257	6	

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	96	GLY	-	EXPRESSION TAG	UNP O43819
A	97	SER	-	EXPRESSION TAG	UNP O43819
A	98	PHE	-	EXPRESSION TAG	UNP O43819
A	99	THR	-	EXPRESSION TAG	UNP O43819

- Molecule 2 is COPPER (I) ION (three-letter code: CU1) (formula: Cu).

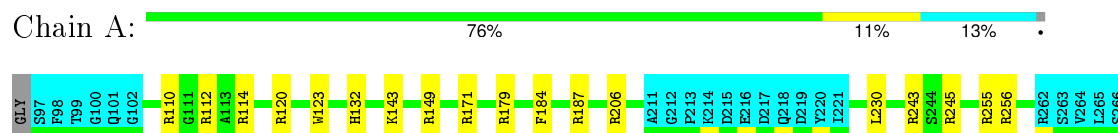
Mol	Chain	Residues	Atoms	
2	A	1	Total	Cu
			1	1

## 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: SCO2 protein homolog, mitochondrial

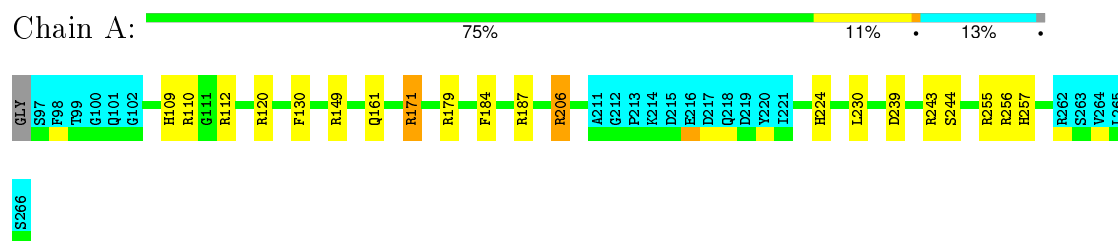


### 4.2 Scores per residue for each member of the ensemble

Colouring as in section 4.1 above.

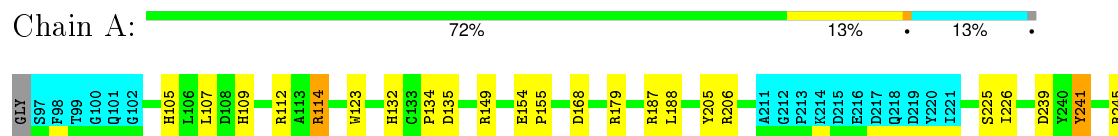
#### 4.2.1 Score per residue for model 1

- Molecule 1: SCO2 protein homolog, mitochondrial



#### 4.2.2 Score per residue for model 2

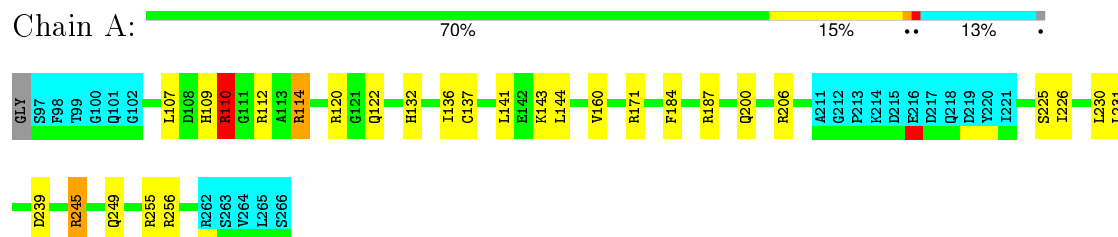
- Molecule 1: SCO2 protein homolog, mitochondrial





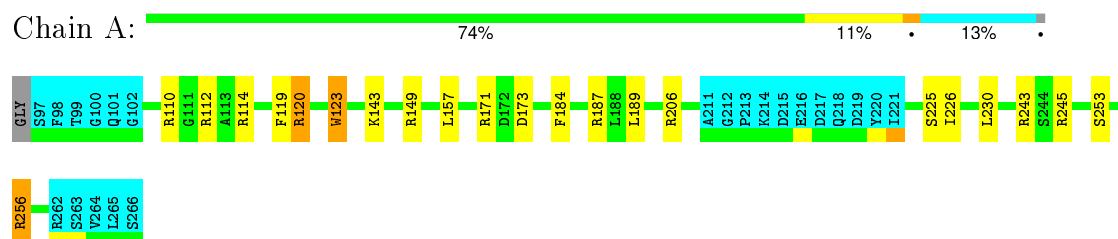
### 4.2.3 Score per residue for model 3 (medoid)

- Molecule 1: SCO2 protein homolog, mitochondrial



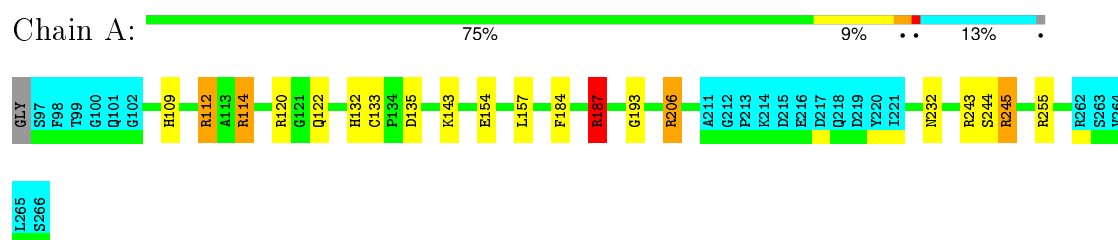
### 4.2.4 Score per residue for model 4

- Molecule 1: SCO2 protein homolog, mitochondrial



### 4.2.5 Score per residue for model 5

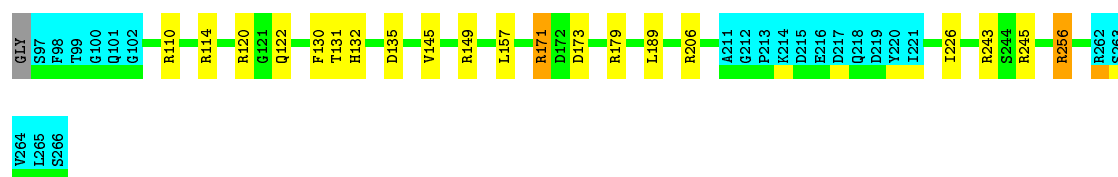
- Molecule 1: SCO2 protein homolog, mitochondrial



### 4.2.6 Score per residue for model 6

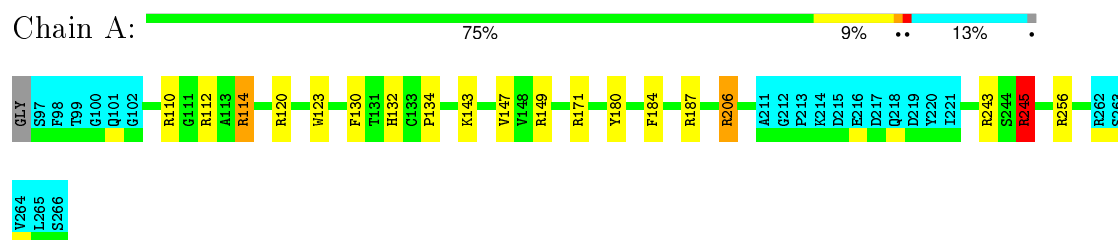
- Molecule 1: SCO2 protein homolog, mitochondrial





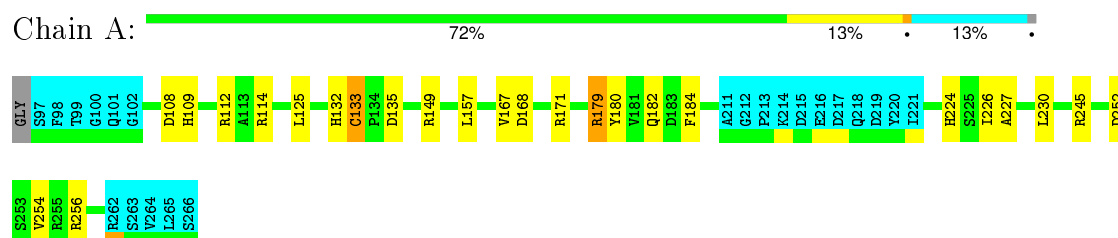
#### 4.2.7 Score per residue for model 7

- Molecule 1: SCO2 protein homolog, mitochondrial



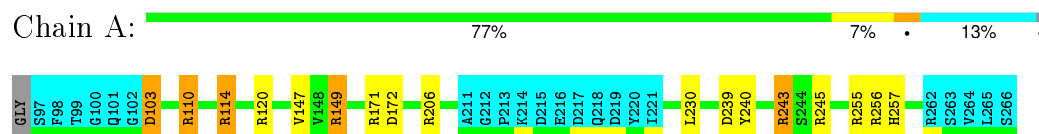
#### 4.2.8 Score per residue for model 8

- Molecule 1: SCO2 protein homolog, mitochondrial



#### 4.2.9 Score per residue for model 9

- Molecule 1: SCO2 protein homolog, mitochondrial



#### 4.2.10 Score per residue for model 10

- Molecule 1: SCO2 protein homolog, mitochondrial

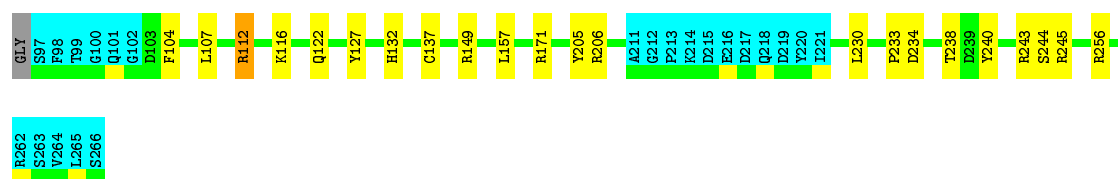




#### 4.2.11 Score per residue for model 11

- Molecule 1: SCO2 protein homolog, mitochondrial

Chain A: 74% 12% 13%



#### 4.2.12 Score per residue for model 12

- Molecule 1: SCO2 protein homolog, mitochondrial

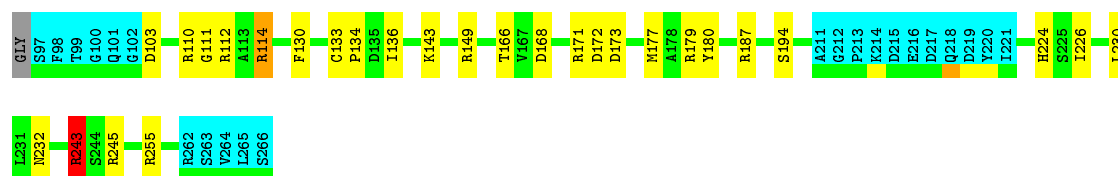
Chain A: 71% 14% 13%



#### 4.2.13 Score per residue for model 13

- Molecule 1: SCO2 protein homolog, mitochondrial

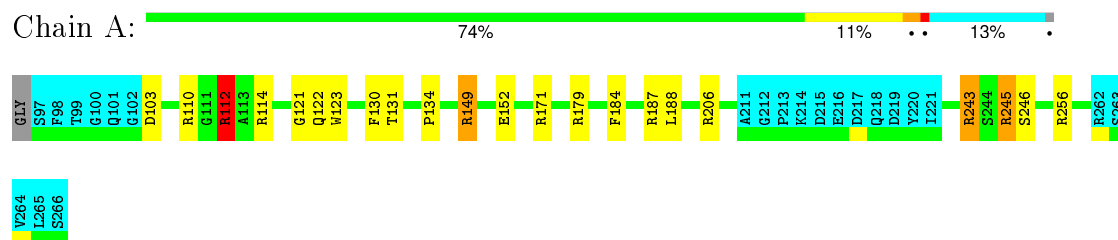
Chain A: 70% 15% 13%



#### 4.2.14 Score per residue for model 14

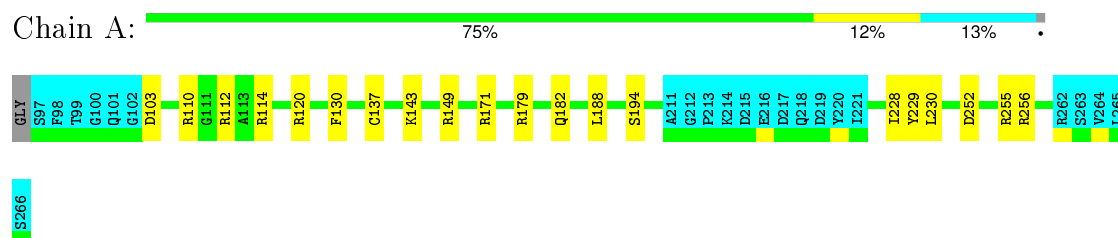
- Molecule 1: SCO2 protein homolog, mitochondrial





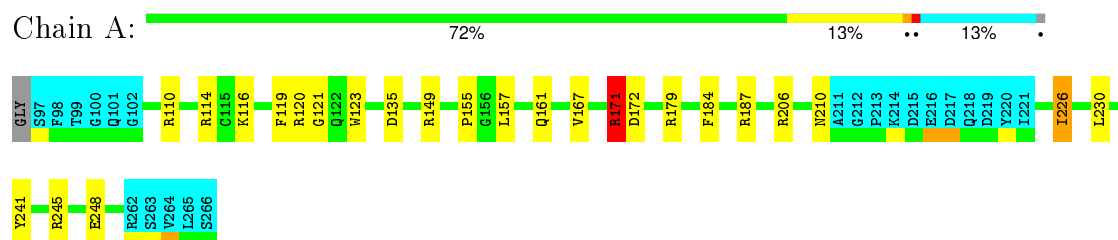
#### 4.2.15 Score per residue for model 15

- Molecule 1: SCO2 protein homolog, mitochondrial



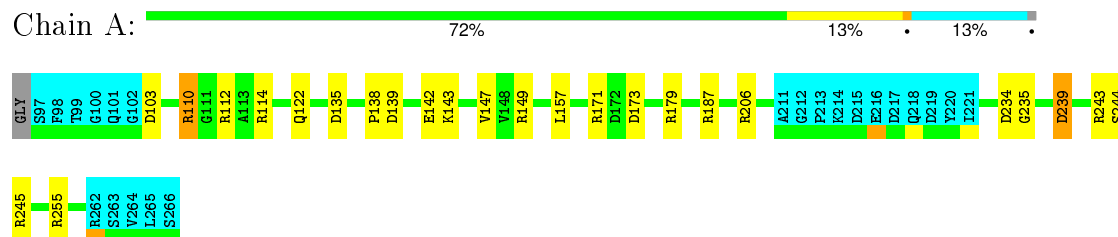
#### 4.2.16 Score per residue for model 16

- Molecule 1: SCO2 protein homolog, mitochondrial



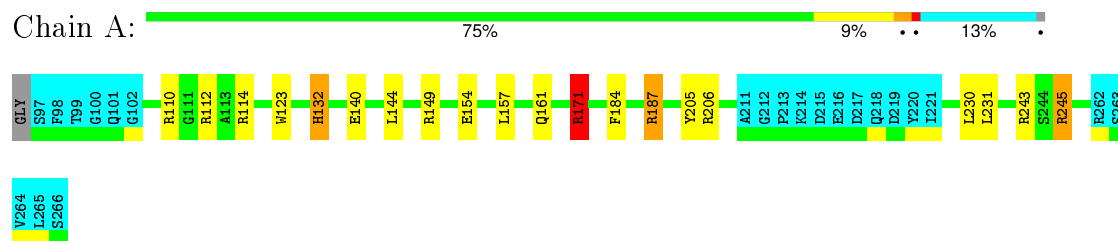
#### 4.2.17 Score per residue for model 17

- Molecule 1: SCO2 protein homolog, mitochondrial



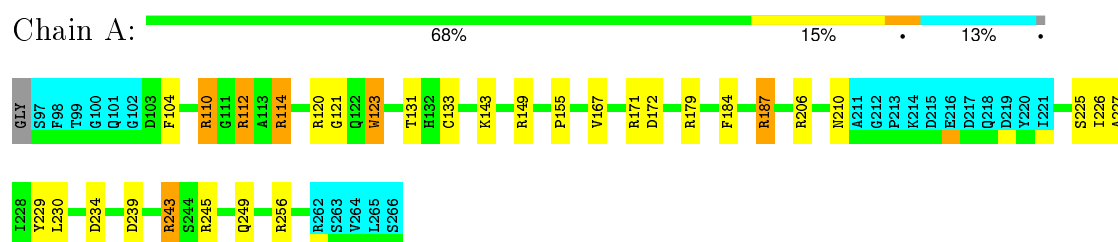
### 4.2.18 Score per residue for model 18

- Molecule 1: SCO2 protein homolog, mitochondrial



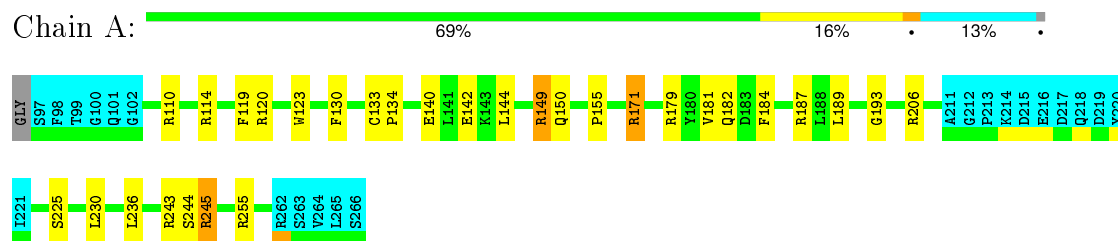
### 4.2.19 Score per residue for model 19

- Molecule 1: SCO2 protein homolog, mitochondrial



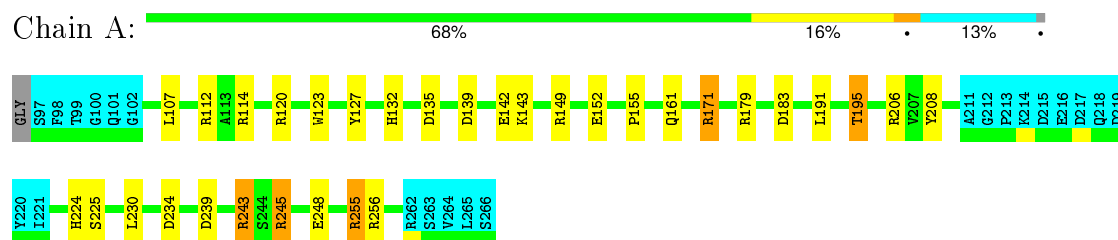
### 4.2.20 Score per residue for model 20

- Molecule 1: SCO2 protein homolog, mitochondrial



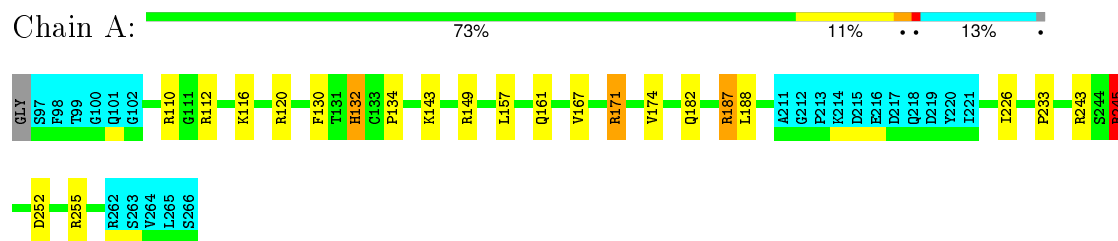
### 4.2.21 Score per residue for model 21

- Molecule 1: SCO2 protein homolog, mitochondrial



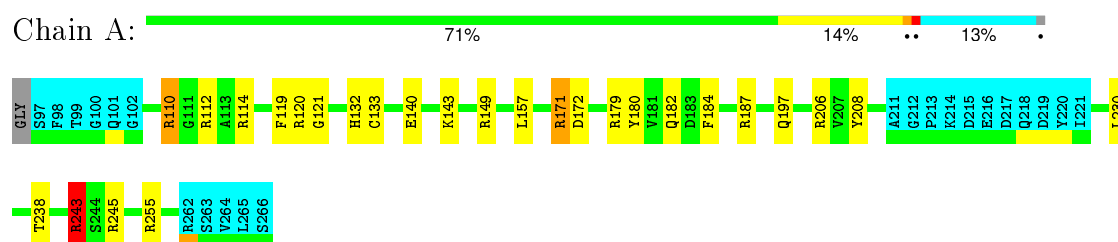
### 4.2.22 Score per residue for model 22

- Molecule 1: SCO2 protein homolog, mitochondrial



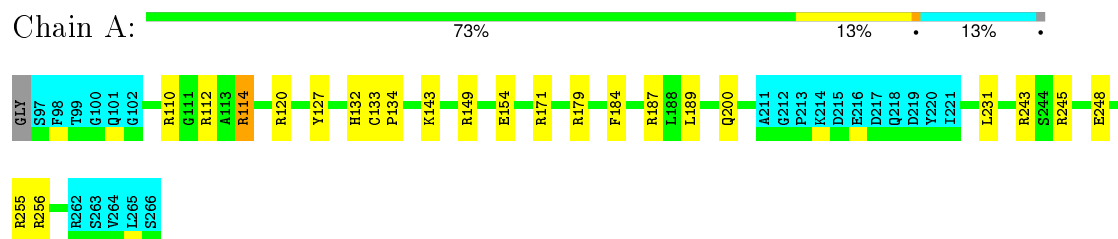
### 4.2.23 Score per residue for model 23

- Molecule 1: SCO2 protein homolog, mitochondrial



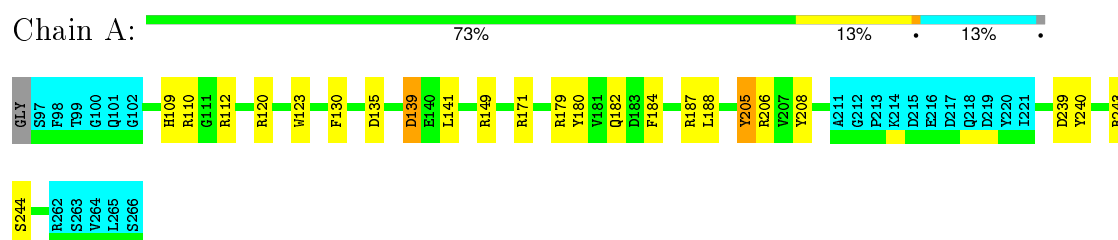
### 4.2.24 Score per residue for model 24

- Molecule 1: SCO2 protein homolog, mitochondrial



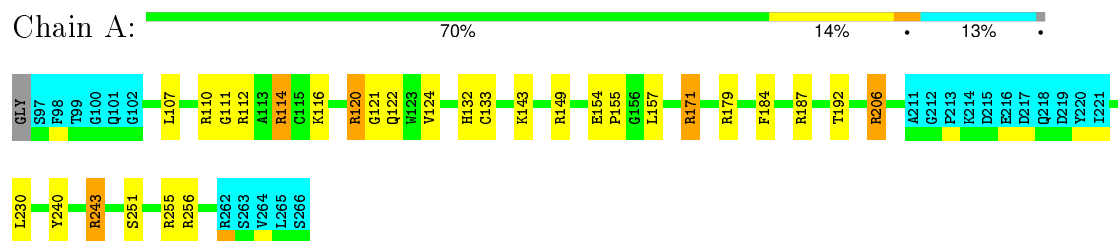
### 4.2.25 Score per residue for model 25

- Molecule 1: SCO2 protein homolog, mitochondrial



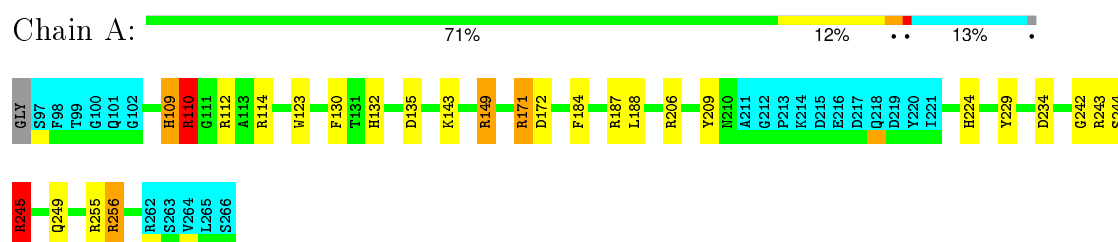
### 4.2.26 Score per residue for model 26

- Molecule 1: SCO2 protein homolog, mitochondrial



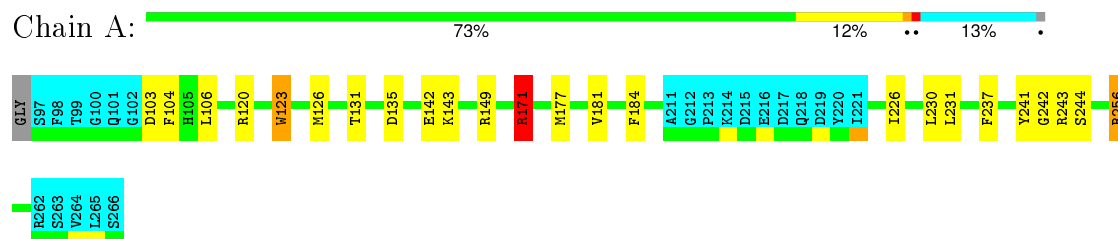
### 4.2.27 Score per residue for model 27

- Molecule 1: SCO2 protein homolog, mitochondrial



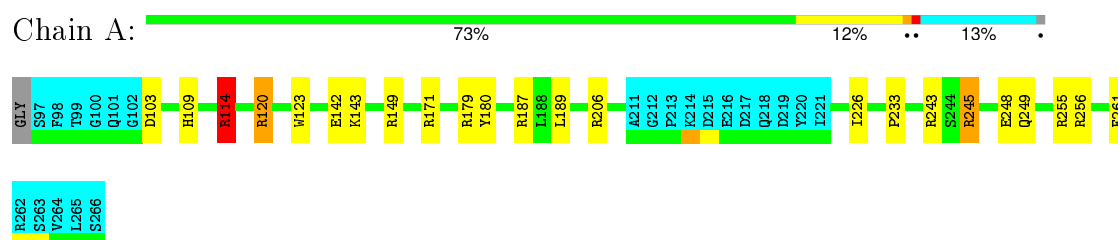
### 4.2.28 Score per residue for model 28

- Molecule 1: SCO2 protein homolog, mitochondrial



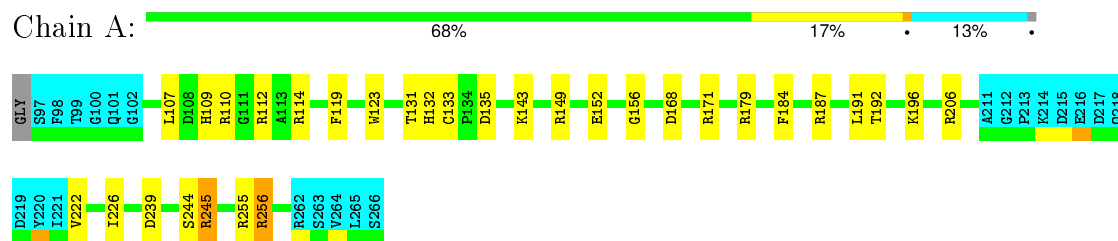
### 4.2.29 Score per residue for model 29

- Molecule 1: SCO2 protein homolog, mitochondrial



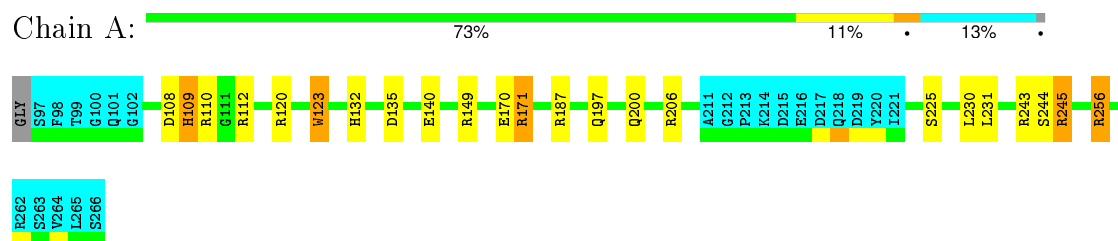
### 4.2.30 Score per residue for model 30

- Molecule 1: SCO2 protein homolog, mitochondrial



### 4.2.31 Score per residue for model 31

- Molecule 1: SCO2 protein homolog, mitochondrial



## 5 Refinement protocol and experimental data overview

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

Of the 350 calculated structures, 31 were deposited, based on the following criterion: *structures with the least restraint violations*.

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

Software name	Classification	Version
DYANA	structure solution	1.5
AMBER	refinement	8.0

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 i

### 6.1 Standard geometry i

Bond lengths and bond angles in the following residue types are not validated in this section: CU1

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	0.73±0.01	0±0/1237 (0.0±0.0%)	1.14±0.03	10±3/1681 (0.6±0.2%)
All	All	0.73	0/38347 (0.0%)	1.14	313/52111 (0.6%)

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	1.2±1.2
All	All	0	38

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	149	ARG	NE-CZ-NH1	9.12	124.86	120.30	30	27
1	A	245	ARG	NE-CZ-NH1	9.09	124.85	120.30	22	19
1	A	179	ARG	NE-CZ-NH1	9.05	124.82	120.30	2	18
1	A	112	ARG	NE-CZ-NH1	8.79	124.69	120.30	5	22
1	A	256	ARG	NE-CZ-NH1	8.59	124.60	120.30	27	20
1	A	120	ARG	NE-CZ-NH1	8.48	124.54	120.30	20	19
1	A	243	ARG	NE-CZ-NH1	8.39	124.49	120.30	6	22
1	A	171	ARG	NE-CZ-NH1	8.11	124.36	120.30	8	22
1	A	114	ARG	NE-CZ-NH2	-7.98	116.31	120.30	26	7
1	A	110	ARG	NE-CZ-NH1	7.93	124.27	120.30	22	18
1	A	187	ARG	NE-CZ-NH1	7.91	124.26	120.30	5	18
1	A	114	ARG	NE-CZ-NH1	7.74	124.17	120.30	9	18

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)	Models	
								Worst	Total
1	A	206	ARG	NE-CZ-NH1	7.35	123.98	120.30	9	17
1	A	255	ARG	NE-CZ-NH1	7.20	123.90	120.30	17	18
1	A	255	ARG	NE-CZ-NH2	-6.81	116.90	120.30	9	3
1	A	256	ARG	NE-CZ-NH2	-6.80	116.90	120.30	6	9
1	A	110	ARG	NE-CZ-NH2	-6.74	116.93	120.30	9	4
1	A	243	ARG	NE-CZ-NH2	-6.64	116.98	120.30	14	3
1	A	179	ARG	NE-CZ-NH2	-6.56	117.02	120.30	1	5
1	A	112	ARG	NE-CZ-NH2	-6.16	117.22	120.30	30	3
1	A	205	TYR	CB-CG-CD2	-6.11	117.34	121.00	12	2
1	A	120	ARG	NE-CZ-NH2	-6.05	117.27	120.30	26	2
1	A	171	ARG	NE-CZ-NH2	-5.90	117.35	120.30	31	2
1	A	245	ARG	NE-CZ-NH2	-5.79	117.40	120.30	7	2
1	A	245	ARG	CD-NE-CZ	5.70	131.57	123.60	7	1
1	A	149	ARG	NE-CZ-NH2	-5.69	117.46	120.30	8	3
1	A	256	ARG	CD-NE-CZ	5.62	131.47	123.60	8	1
1	A	187	ARG	NE-CZ-NH2	-5.60	117.50	120.30	17	5
1	A	206	ARG	NE-CZ-NH2	-5.51	117.55	120.30	12	1
1	A	243	ARG	CD-NE-CZ	5.41	131.18	123.60	6	1
1	A	179	ARG	CD-NE-CZ	5.25	130.95	123.60	20	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	241	TYR	Sidechain	3
1	A	245	ARG	Sidechain	3
1	A	114	ARG	Sidechain	3
1	A	110	ARG	Peptide,Sidechain	2
1	A	103	ASP	Peptide	2
1	A	256	ARG	Sidechain	2
1	A	171	ARG	Peptide,Sidechain	2
1	A	132	HIS	Peptide,Sidechain	2
1	A	243	ARG	Sidechain	2
1	A	112	ARG	Sidechain	2
1	A	205	TYR	Sidechain	1
1	A	180	TYR	Sidechain	1
1	A	157	LEU	Peptide	1
1	A	156	GLY	Peptide	1
1	A	179	ARG	Sidechain	1
1	A	240	TYR	Sidechain	1

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Mol	Chain	Res	Type	Group	Models (Total)
1	A	227	ALA	Peptide	1
1	A	138	PRO	Peptide	1
1	A	121	GLY	Peptide	1
1	A	149	ARG	Sidechain	1
1	A	187	ARG	Sidechain	1
1	A	109	HIS	Peptide	1
1	A	133	CYS	Peptide	1
1	A	244	SER	Peptide	1
1	A	154	GLU	Peptide	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	1203	1154	1153	0±0
All	All	37324	35774	35743	4

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 0.

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

Atom-1	Atom-2	Clash(Å)	Distance(Å)	Models	
				Worst	Total
1:A:166:THR:HG22	1:A:168:ASP:H	0.53	1.63	13	1
1:A:136:ILE:HG23	1:A:137:CYS:H	0.50	1.65	3	1
1:A:132:HIS:CG	1:A:133:CYS:H	0.45	2.29	8	1
1:A:166:THR:HG21	1:A:172:ASP:CB	0.41	2.46	13	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	148/171 (87%)	125±4 (85±3%)	18±4 (12±2%)	5±2 (3±2%)	8	38
All	All	4588/5301 (87%)	3883 (85%)	551 (12%)	154 (3%)	8	38

All 49 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	135	ASP	11
1	A	226	ILE	10
1	A	132	HIS	8
1	A	244	SER	8
1	A	109	HIS	7
1	A	134	PRO	7
1	A	245	ARG	7
1	A	225	SER	6
1	A	171	ARG	6
1	A	155	PRO	6
1	A	187	ARG	5
1	A	110	ARG	5
1	A	243	ARG	5
1	A	121	GLY	4
1	A	122	GLN	4
1	A	123	TRP	4
1	A	233	PRO	3
1	A	168	ASP	3
1	A	154	GLU	3
1	A	157	LEU	3
1	A	131	THR	3
1	A	193	GLY	2
1	A	167	VAL	2
1	A	111	GLY	2
1	A	120	ARG	2
1	A	206	ARG	2
1	A	103	ASP	2
1	A	242	GLY	2
1	A	133	CYS	2
1	A	237	PHE	1
1	A	222	VAL	1
1	A	261	PHE	1
1	A	227	ALA	1
1	A	181	VAL	1
1	A	235	GLY	1
1	A	172	ASP	1

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Mol	Chain	Res	Type	Models (Total)
1	A	234	ASP	1
1	A	248	GLU	1
1	A	195	THR	1
1	A	112	ARG	1
1	A	136	ILE	1
1	A	174	VAL	1
1	A	139	ASP	1
1	A	236	LEU	1
1	A	130	PHE	1
1	A	239	ASP	1
1	A	194	SER	1
1	A	208	TYR	1
1	A	205	TYR	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	129/147 (88%)	116±3 (90±2%)	13±3 (10±2%)	14	59
All	All	3999/4557 (88%)	3605 (90%)	394 (10%)	14	59

All 93 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	184	PHE	19
1	A	230	LEU	18
1	A	143	LYS	18
1	A	123	TRP	16
1	A	114	ARG	15
1	A	171	ARG	13
1	A	245	ARG	11
1	A	130	PHE	10
1	A	206	ARG	9
1	A	239	ASP	9
1	A	132	HIS	8
1	A	107	LEU	7

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Mol	Chain	Res	Type	Models (Total)
1	A	157	LEU	7
1	A	188	LEU	7
1	A	182	GLN	6
1	A	133	CYS	6
1	A	224	HIS	6
1	A	112	ARG	6
1	A	119	PHE	6
1	A	231	LEU	6
1	A	140	GLU	5
1	A	161	GLN	5
1	A	103	ASP	5
1	A	149	ARG	5
1	A	243	ARG	5
1	A	187	ARG	5
1	A	234	ASP	5
1	A	122	GLN	5
1	A	256	ARG	5
1	A	180	TYR	5
1	A	189	LEU	5
1	A	142	GLU	5
1	A	249	GLN	5
1	A	172	ASP	4
1	A	226	ILE	4
1	A	173	ASP	4
1	A	109	HIS	4
1	A	200	GLN	4
1	A	116	LYS	4
1	A	110	ARG	4
1	A	248	GLU	3
1	A	144	LEU	3
1	A	139	ASP	3
1	A	104	PHE	3
1	A	152	GLU	3
1	A	147	VAL	3
1	A	127	TYR	3
1	A	229	TYR	3
1	A	240	TYR	3
1	A	120	ARG	3
1	A	135	ASP	3
1	A	252	ASP	3
1	A	177	MET	2
1	A	191	LEU	2

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Mol	Chain	Res	Type	Models (Total)
1	A	108	ASP	2
1	A	183	ASP	2
1	A	194	SER	2
1	A	137	CYS	2
1	A	192	THR	2
1	A	225	SER	2
1	A	257	HIS	2
1	A	197	GLN	2
1	A	210	ASN	2
1	A	131	THR	2
1	A	208	TYR	2
1	A	238	THR	2
1	A	253	SER	2
1	A	167	VAL	2
1	A	246	SER	2
1	A	232	ASN	2
1	A	141	LEU	2
1	A	150	GLN	2
1	A	205	TYR	2
1	A	181	VAL	1
1	A	179	ARG	1
1	A	195	THR	1
1	A	160	VAL	1
1	A	106	LEU	1
1	A	154	GLU	1
1	A	209	TYR	1
1	A	244	SER	1
1	A	105	HIS	1
1	A	241	TYR	1
1	A	251	SER	1
1	A	254	VAL	1
1	A	145	VAL	1
1	A	170	GLU	1
1	A	125	LEU	1
1	A	126	MET	1
1	A	255	ARG	1
1	A	124	VAL	1
1	A	228	ILE	1
1	A	196	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](#)

Of 1 ligands modelled in this entry, 1 is monoatomic - leaving 0 for Mogul analysis.

## 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