Full wwPDB NMR Structure Validation Report (i)

Apr 21, 2024 – 09:20 AM EDT

PDB ID	:	2L1U
Title	:	Structure-Functional Analysis of Mammalian MsrB2 protein
Authors	:	Aachmann, F.L.; Del Conte, R.; Kwak, G.; Kim, H.; Gladyshev, V.N.; Dikiy, A.
Deposited on	:	2010-08-06

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 types of validation reports are described at
http://www.wwpdb.org/validation/2017/FAQs#types.

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

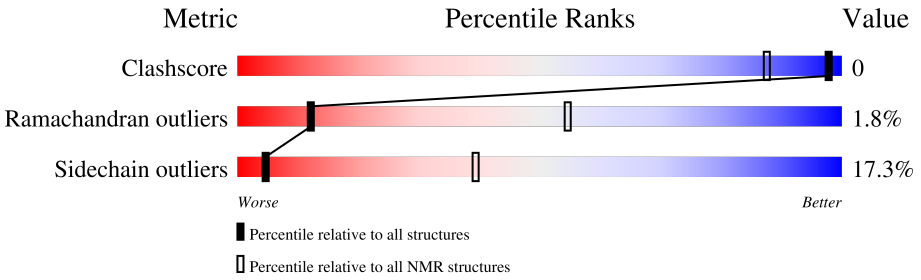
MolProbity	:	4.02b-467
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
wwPDB-RCI	:	v_1n_11_5_13_A (Berjanski et al., 2005)
PANAV	:	Wang et al. (2010)
wwPDB-ShiftChecker	:	v1.2
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36.2

1 Overall quality at a glance (i)

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 >=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	143	48% 6% • 44%

2 Ensemble composition and analysis (i)

This entry contains 20 models. Model 15 is the overall representative, medoid model (most similar to other models). The authors have identified model 1 as representative, based on the following criterion: *fewest violations*.

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:35-A:54, A:61-A:66, A:78-A:131 (80)	1.13	15

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 6 single-model clusters were found.

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

3 Entry composition (i)

There are 2 unique types of molecules in this entry. The entry contains 2187 atoms, of which 1065 are hydrogens and 0 are deuteriums.

- Molecule 1 is a protein called Methionine-R-sulfoxide reductase B2, mitochondrial.

Mol	Chain	Residues	Atoms						Trace
			Total	C	H	N	O	S	
1	A	143	2186	703	1065	199	207	12	0

There are 12 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1	MET	-	expression tag	UNP Q78J03
A	133	ALA	-	expression tag	UNP Q78J03
A	134	ALA	-	expression tag	UNP Q78J03
A	135	ALA	-	expression tag	UNP Q78J03
A	136	LEU	-	expression tag	UNP Q78J03
A	137	GLU	-	expression tag	UNP Q78J03
A	138	HIS	-	expression tag	UNP Q78J03
A	139	HIS	-	expression tag	UNP Q78J03
A	140	HIS	-	expression tag	UNP Q78J03
A	141	HIS	-	expression tag	UNP Q78J03
A	142	HIS	-	expression tag	UNP Q78J03
A	143	HIS	-	expression tag	UNP Q78J03

- Molecule 2 is ZINC ION (three-letter code: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms	
			Total	Zn
2	A	1	1	1

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: Methionine-R-sulfoxide reductase B2, mitochondrial

Chain A: 48% 6% • 44%

M1 A2 D3 W4 Q5 K6 K7 L8 T9 P10 E11 Q12 F13 Y14 V15 T16 R17 E18 K19 G20 T21 E22 A23 P24 F25 S26 G27 M28 Y29 L30 N31 N32 K33 E34 D44 S50 C55 S56 G57 T58 G59 W60 Y67 G68 S69 K70 G71 S72 D73 E74 S75 H76 T77 L80 R81

R82 R91 H105 K112 R117 N121 S130 K131 P132 A133 A134 A135 L136 E137 H138 H139 H140 H141 H142 H143

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: Methionine-R-sulfoxide reductase B2, mitochondrial

Chain A: 44% 10% • 44%

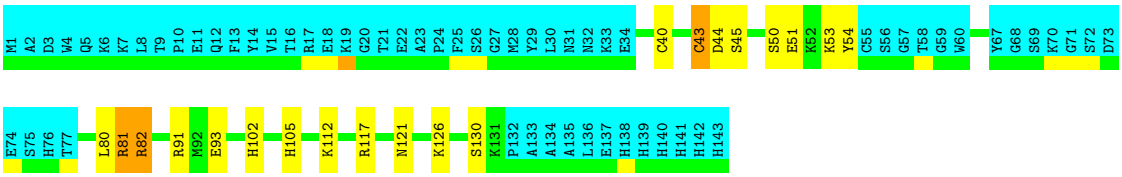
M1 A2 D3 W4 Q5 K6 K7 L8 T9 P10 E11 Q12 F13 Y14 V15 T16 R17 E18 K19 G20 T21 E22 A23 P24 F25 S26 G27 M28 Y29 L30 N31 N32 K33 E34 L47 S50 E51 K52 K53 Y54 C55 S56 G57 T58 G59 W60 S64 Y67 G68 S69 K70 G71 S72 D73 E74 S75

H76 T77 R81 R82 S86 R91 C99 H105 P111 K112 R117 F118 S130 K131 P132 A133 A134 A135 L136 E137 H138 H139 H140 H141 H142 H143

4.2.2 Score per residue for model 2

• Molecule 1: Methionine-R-sulfoxide reductase B2, mitochondrial

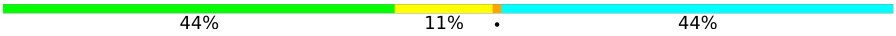
Chain A: 42% 12% • 44%

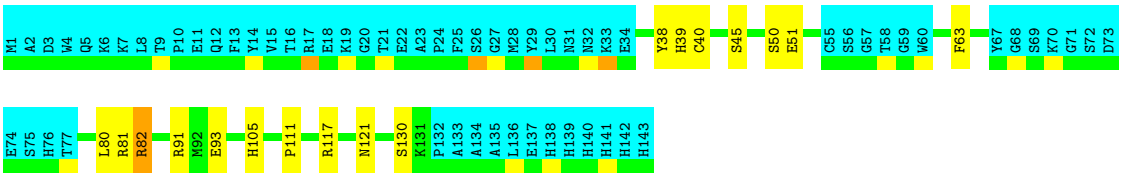


4.2.3 Score per residue for model 3

- Molecule 1: Methionine-R-sulfoxide reductase B2, mitochondrial

Chain A:

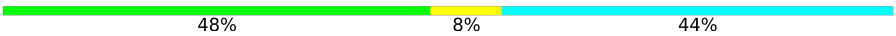


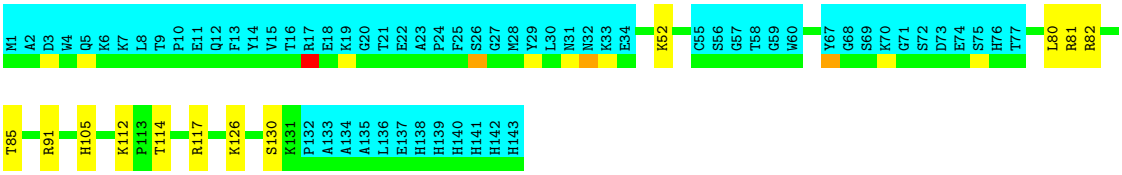


4.2.4 Score per residue for model 4

- Molecule 1: Methionine-R-sulfoxide reductase B2, mitochondrial

Chain A:

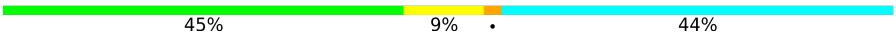


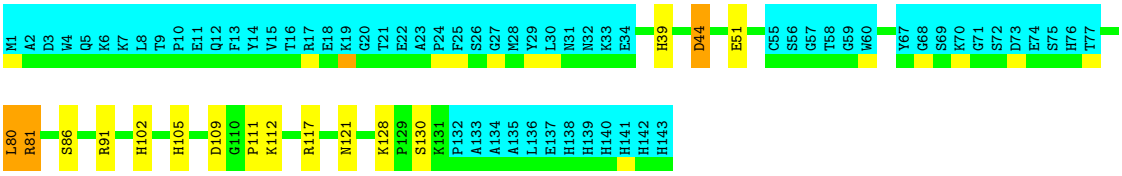


4.2.5 Score per residue for model 5

- Molecule 1: Methionine-R-sulfoxide reductase B2, mitochondrial

Chain A:





4.2.6 Score per residue for model 6

- Molecule 1: Methionine-R-sulfoxide reductase B2, mitochondrial

Chain A: 46% 8% • 44%

M1 A2 D3 W4 Q5 K6 K7 L8 T9 P10 E11 Q12 F13 Y14 V15 T16 R17 E18 K19 G20 T21 E22 A23 P24 F25 S26 G27 M28 Y29 L30 N31 N32 K33 E34 C40 D44 L47 C55 S56 G57 T58 G59 W60 P61 Y67 G68 S69 K70 G71 S72 D73 E74 S75 H76 T77

G78 R81 R82 K97 H105 P111 R117 S122 S130 K131 P132 A133 A134 A135 L136 E137 H138 H139 H140 H141 H142 H143

4.2.7 Score per residue for model 7

- Molecule 1: Methionine-R-sulfoxide reductase B2, mitochondrial

Chain A: 45% 9% • 44%

M1 A2 D3 W4 Q5 K6 K7 L8 T9 P10 E11 Q12 F13 Y14 V15 T16 R17 E18 K19 G20 T21 E22 A23 P24 F25 S26 G27 M28 Y29 L30 N31 N32 K33 E34 D44 K52 C55 S56 G57 T58 G59 W60 Y67 G68 S69 K70 G71 S72 D73 E74 S75 H76 T77 L80 R81

R82 T85 R91 H102 H105 Q116 R117 F118 N121 K126 S130 K131 P132 A133 A134 A135 L136 E137 H138 H139 H140 H141 H142 H143

4.2.8 Score per residue for model 8

- Molecule 1: Methionine-R-sulfoxide reductase B2, mitochondrial

Chain A: 47% 8% • 44%

M1 A2 D3 W4 Q5 K6 K7 L8 T9 P10 E11 Q12 F13 Y14 V15 T16 R17 E18 K19 G20 T21 E22 A23 P24 F25 S26 G27 M28 Y29 L30 N31 N32 K33 E34 T35 D44 S45 P46 L47 S50 C55 S56 G57 T58 G59 W60 Y67 G68 S69 K70 G71 S72 D73 E74 S75 H76

T77 R81 R82 R91 C99 L103 P111 K112 N121 P132 A133 A134 A135 L136 E137 H138 H139 H140 H141 H142 H143

4.2.9 Score per residue for model 9

- Molecule 1: Methionine-R-sulfoxide reductase B2, mitochondrial

Chain A: 44% 10% •• 44%

M1 A2 D3 W4 Q5 K6 K7 L8 T9 P10 E11 Q12 F13 Y14 V15 T16 R17 E18 K19 G20 T21 E22 A23 P24 F25 S26 G27 M28 Y29 L30 N31 N32 K33 E34 Y38 H39 C40 D44 L47 S50 C55 S56 G57 T58 G59 W60 Y67 G68 S69 K70 G71 S72 D73 E74

S75 H76 T77 L80 R81 R82 L83 D84 T85 H105 T114 G115 Q116 R117 N121 S130 K131 P132 A133 A134 A135 L136 E137 H138 H139 H140 H141 H142 H143

4.2.10 Score per residue for model 10

- Molecule 1: Methionine-R-sulfoxide reductase B2, mitochondrial

Chain A: 48% 7% • 44%

M1 A2 D3 W4 Q5 K6 K7 L8 T9 P10 E11 Q12 F13 Y14 V15 T16 R17 E18 K19 G20 T21 E22 A23 P24 F25 S26 G27 M28 Y29 L30 N31 N32 K33 E34 S45 K52 C55 S56 G57 T58 G59 W60 Y67 G68 S69 K70 G71 S72 D73 E74 S75 H76 T77 L80 R81

R82 H102 F107 R117 F118 N121 K126 S130 K131 P132 A133 A134 A135 L136 E137 H138 H139 H140 H141 H142 H143

4.2.11 Score per residue for model 11

- Molecule 1: Methionine-R-sulfoxide reductase B2, mitochondrial

Chain A: 41% 13% • 44%

M1 A2 D3 W4 Q5 K6 K7 L8 T9 P10 E11 Q12 F13 Y14 V15 T16 R17 E18 K19 G20 T21 E22 A23 P24 F25 S26 G27 M28 Y29 L30 N31 N32 K33 E34 T35 Y38 D44 L47 E51 C55 S56 G57 T58 G59 W60 P61 Y67 G68 S69 K70 G71 S72 D73 E74

S75 H76 T77 G78 I79 L80 R81 R82 S86 R91 M92 K97 H105 K112 P113 T114 R117 N121 K126 S130 K131 P132 A133 A134 A135 L136 E137 H138 H139 H140 H141 H142 H143

4.2.12 Score per residue for model 12

- Molecule 1: Methionine-R-sulfoxide reductase B2, mitochondrial

Chain A: 45% 9% •• 44%

M1 A2 D3 W4 Q5 K6 K7 L8 T9 P10 E11 Q12 F13 Y14 V15 T16 R17 E18 K19 G20 T21 E22 A23 P24 F25 S26 G27 M28 Y29 L30 N31 N32 K33 E34 T35 H39 D44 S50 C55 S56 G57 T58 G59 W60 Y67 G68 S69 K70 G71 S72 D73 E74 S75 H76 T77

L80 R81 R82 T85 S86 H102 P111 K112 R117 N121 S130 K131 P132 A133 A134 A135 L136 E137 H138 H139 H140 H141 H142 H143

4.2.13 Score per residue for model 13

- Molecule 1: Methionine-R-sulfoxide reductase B2, mitochondrial

Chain A: 45% 10% • 44%

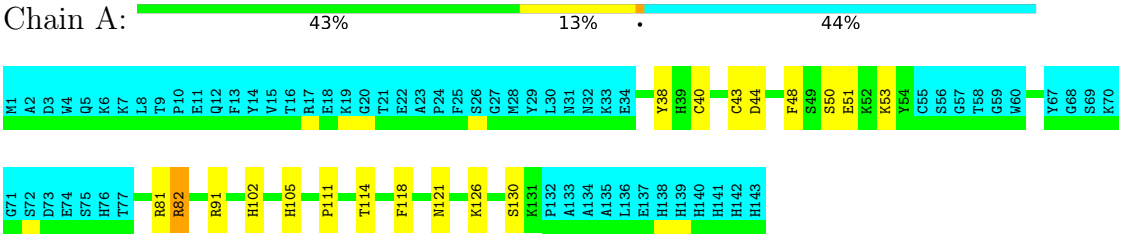
M1 A2 D3 W4 Q5 K6 K7 L8 T9 P10 E11 Q12 F13 Y14 V15 T16 R17 E18 K19 G20 T21 E22 A23 P24 F25 S26 G27 M28 Y29 L30 N31 N32 K33 E34 H39 S45 S50 E51 C55 S56 G57 T58 G59 W60 Y67 G68 S69 K70 G71 S72 D73 E74 S75 H76 T77

L80 R81 R82 T85 R91 V95 C99 E100 L103 G104 H105 S130 K131 P132 A133 A134 A135 L136 E137 H138 H139 H140 H141 H142 H143

4.2.14 Score per residue for model 14

- Molecule 1: Methionine-R-sulfoxide reductase B2, mitochondrial

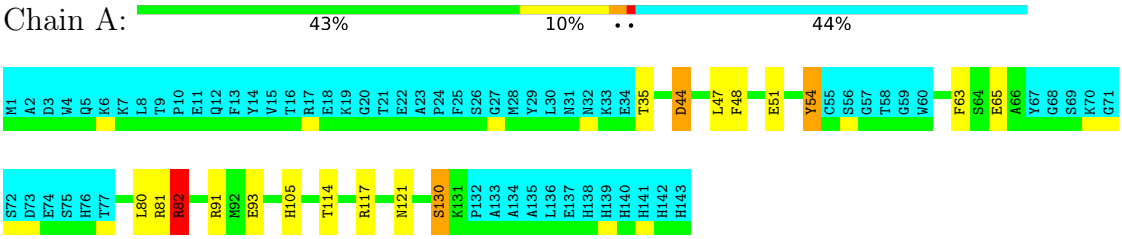
Chain A:



4.2.15 Score per residue for model 15 (medoid)

- Molecule 1: Methionine-R-sulfoxide reductase B2, mitochondrial

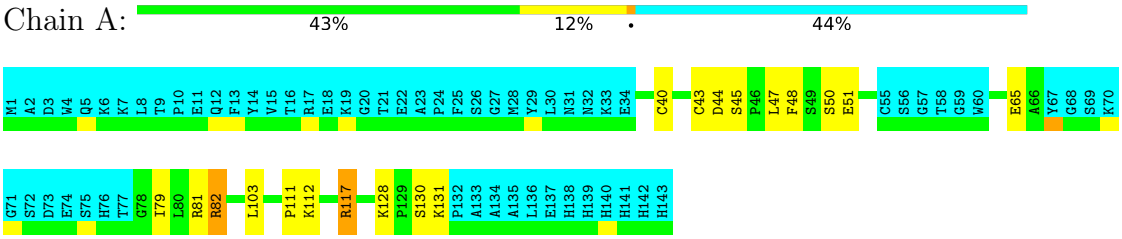
Chain A:



4.2.16 Score per residue for model 16

- Molecule 1: Methionine-R-sulfoxide reductase B2, mitochondrial

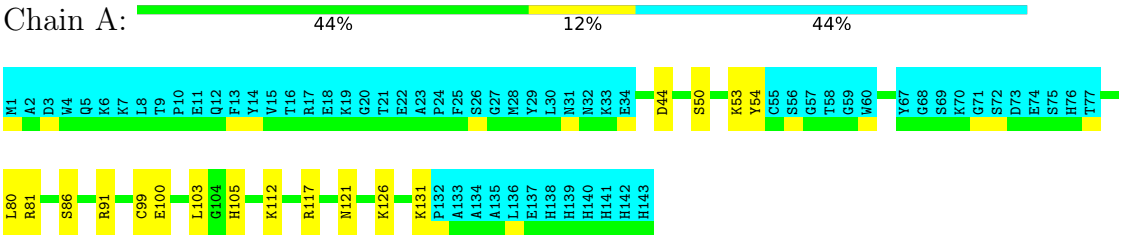
Chain A:



4.2.17 Score per residue for model 17

- Molecule 1: Methionine-R-sulfoxide reductase B2, mitochondrial

Chain A:



4.2.18 Score per residue for model 18

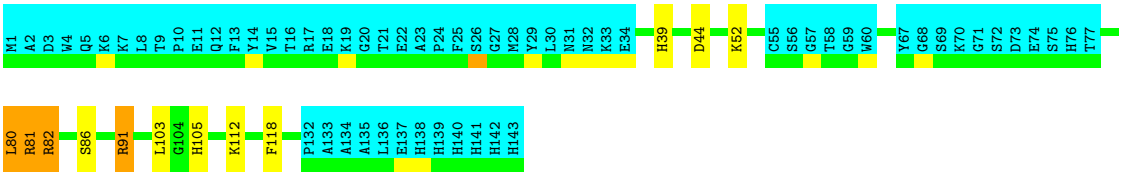
- Molecule 1: Methionine-R-sulfoxide reductase B2, mitochondrial

Chain A: 44% 11% • 44%

4.2.19 Score per residue for model 19

- Molecule 1: Methionine-R-sulfoxide reductase B2, mitochondrial

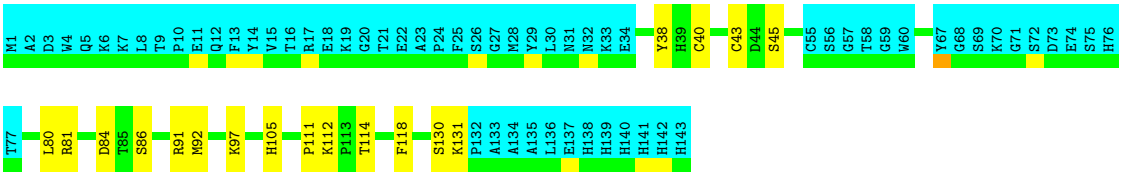
Chain A: 48% 6% • 44%



4.2.20 Score per residue for model 20

- Molecule 1: Methionine-R-sulfoxide reductase B2, mitochondrial

Chain A: 43% 13% 44%



5 Refinement protocol and experimental data overview (i)

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

Of the 96 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
TALOS	geometry optimization	
Amber	refinement	10
CYANA	structure solution	2.1

No chemical shift data was provided.

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: ZN

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	0.69±0.01	0±0/633 (0.0± 0.0%)	1.16±0.04	3±1/853 (0.3± 0.1%)
All	All	0.69	0/12660 (0.0%)	1.16	55/17060 (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	1.2±1.0
All	All	0	24

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(^{o})	Ideal(^{o})	Models	
								Worst	Total
1	A	82	ARG	NE-CZ-NH1	10.30	125.45	120.30	3	14
1	A	81	ARG	NE-CZ-NH1	10.15	125.37	120.30	13	9
1	A	117	ARG	NE-CZ-NH1	9.12	124.86	120.30	9	15
1	A	91	ARG	NE-CZ-NH1	8.76	124.68	120.30	11	14
1	A	117	ARG	NE-CZ-NH2	-6.43	117.08	120.30	9	1
1	A	82	ARG	NE-CZ-NH2	5.79	123.19	120.30	18	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	44	ASP	Peptide	6
1	A	82	ARG	Sidechain	4
1	A	81	ARG	Sidechain	3
1	A	54	TYR	Sidechain	2
1	A	65	GLU	Peptide	2
1	A	64	SER	Peptide	1
1	A	78	GLY	Peptide	1
1	A	105	HIS	Peptide	1
1	A	45	SER	Peptide	1
1	A	38	TYR	Sidechain	1
1	A	85	THR	Peptide	1
1	A	91	ARG	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	616	610	610	1±1
All	All	12340	12200	12200	11

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:40:CYS:CB	1:A:43:CYS:SG	0.46	3.04	2	4
1:A:35:THR:HG23	1:A:130:SER:HB2	0.46	1.86	15	1
1:A:80:LEU:HD23	1:A:81:ARG:H	0.45	1.71	12	4
1:A:95:VAL:HG12	1:A:103:LEU:H	0.43	1.73	13	1
1:A:35:THR:HG23	1:A:130:SER:CB	0.40	2.46	15	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	80/143 (56%)	69±2 (87±3%)	9±2 (12±3%)	1±1 (2±1%)	12 54
All	All	1600/2860 (56%)	1385 (87%)	186 (12%)	29 (2%)	12 54

All 9 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	111	PRO	9
1	A	44	ASP	8
1	A	85	THR	4
1	A	61	PRO	2
1	A	100	GLU	2
1	A	122	SER	1
1	A	116	GLN	1
1	A	114	THR	1
1	A	123	VAL	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	71/123 (58%)	59±2 (83±3%)	12±2 (17±3%)	5 39
All	All	1420/2460 (58%)	1175 (83%)	245 (17%)	5 39

All 42 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	130	SER	17
1	A	105	HIS	16
1	A	81	ARG	15
1	A	80	LEU	15
1	A	82	ARG	14
1	A	121	ASN	12
1	A	50	SER	11

Continued on next page...

Continued from previous page...

Mol	Chain	Res	Type	Models (Total)
1	A	112	LYS	11
1	A	51	GLU	9
1	A	47	LEU	8
1	A	86	SER	8
1	A	126	LYS	8
1	A	114	THR	7
1	A	52	LYS	6
1	A	118	PHE	6
1	A	45	SER	6
1	A	102	HIS	6
1	A	131	LYS	6
1	A	39	HIS	5
1	A	44	ASP	5
1	A	103	LEU	5
1	A	99	CYS	4
1	A	93	GLU	4
1	A	38	TYR	4
1	A	117	ARG	3
1	A	53	LYS	3
1	A	54	TYR	3
1	A	40	CYS	3
1	A	97	LYS	3
1	A	35	THR	3
1	A	48	PHE	3
1	A	63	PHE	2
1	A	128	LYS	2
1	A	84	ASP	2
1	A	79	ILE	2
1	A	92	MET	2
1	A	43	CYS	1
1	A	109	ASP	1
1	A	116	GLN	1
1	A	107	PHE	1
1	A	91	ARG	1
1	A	94	VAL	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)

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 (i)

No chemical shift data were provided