



# Full wwPDB X-ray Structure Validation Report ⓘ

Jan 24, 2023 – 11:24 AM EST

PDB ID : 3MSQ  
Title : Crystal structure of a Putative ubiquinone biosynthesis protein (Npun02000094) from Nostoc punctiforme PCC 73102 at 2.85 Å resolution  
Authors : Joint Center for Structural Genomics (JCSG)  
Deposited on : 2010-04-29  
Resolution : 2.85 Å (reported)

This is a Full wwPDB X-ray 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/XrayValidationReportHelp>

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>.

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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  
Mogul : 1.8.5 (274361), CSD as541be (2020)  
Xtriage (Phenix) : 1.13  
EDS : 2.31.2  
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)  
Refmac : 5.8.0158  
CCP4 : 7.0.044 (Gargrove)  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : 2.31.2

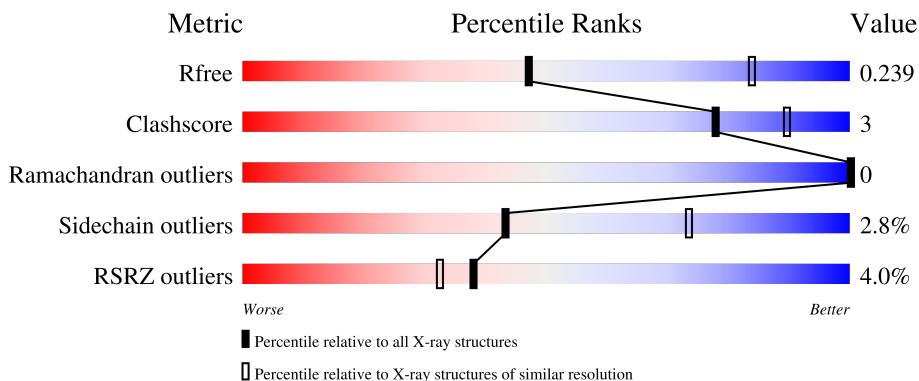
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*


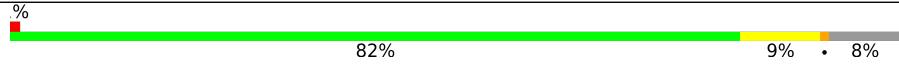
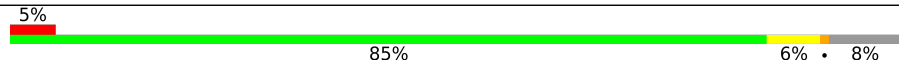

The reported resolution of this entry is 2.85 Å.

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)	Similar resolution (#Entries, resolution range(Å))
$R_{free}$	130704	3168 (2.90-2.82)
Clashscore	141614	3438 (2.90-2.82)
Ramachandran outliers	138981	3348 (2.90-2.82)
Sidechain outliers	138945	3351 (2.90-2.82)
RSRZ outliers	127900	3103 (2.90-2.82)

The table below summarises the geometric issues observed across the polymeric chains and their fit to the electron density. The red, orange, yellow and green segments of the lower bar indicate the fraction of residues that contain outliers for  $\geq 3$ , 2, 1 and 0 types of geometric quality criteria respectively. 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  $\leq 5\%$ . The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density. The numeric value is given above the bar.

Mol	Chain	Length	Quality of chain
1	A	224	 5% 83% 8% • 8%
1	B	224	 5% 82% 9% • 8%
1	C	224	 5% 85% 6% • 8%
1	D	224	 6% 85% 7% • 8%

## 2 Entry composition

There is only 1 type of molecule in this entry. The entry contains 6552 atoms, of which 0 are hydrogens and 0 are deuteriums.

In the tables below, the ZeroOcc column contains the number of atoms modelled with zero occupancy, the AltConf column contains the number of residues with at least one atom in alternate conformation and the Trace column contains the number of residues modelled with at most 2 atoms.

- Molecule 1 is a protein called Putative ubiquinone biosynthesis protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	Se			
1	A	207	1643	1066	271	299	7	0	0	0
1	B	207	1633	1060	267	299	7	0	0	0
1	C	207	1637	1063	268	299	7	0	0	0
1	D	207	1639	1063	270	299	7	0	0	0

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	0	GLY	-	expression tag	UNP B2J5W7
B	0	GLY	-	expression tag	UNP B2J5W7
C	0	GLY	-	expression tag	UNP B2J5W7
D	0	GLY	-	expression tag	UNP B2J5W7



L149	T152	L161	V166	M167	G186	K196	S221	ILE	LEU
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## 4 Data and refinement statistics i

Property	Value	Source
Space group	P 2 2 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	81.72Å 82.03Å 187.64Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	49.27 – 2.85 49.27 – 2.85	Depositor EDS
% Data completeness (in resolution range)	(Not available) (49.27-2.85) 87.2 (49.27-2.85)	Depositor EDS
$R_{merge}$	0.09	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.70 (at 2.86Å)	Xtrriage
Refinement program	PHENIX, BUSTER 2.8.0	Depositor
R, $R_{free}$	0.195 , 0.223 0.206 , 0.239	Depositor DCC
$R_{free}$ test set	1323 reflections (5.02%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	69.2	Xtrriage
Anisotropy	0.135	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.33 , 49.0	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.31$	Xtrriage
Estimated twinning fraction	0.026 for k,h,-l	Xtrriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	6552	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	74.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.66% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical values of  $\langle |L| \rangle$ ,  $\langle L^2 \rangle$  for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 0.2 for perfectly twinned datasets.

## 5 Model quality [i](#)

### 5.1 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 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	0.51	0/1674	0.69	0/2257
1	B	0.51	0/1664	0.69	0/2246
1	C	0.52	1/1668 (0.1%)	0.70	0/2250
1	D	0.48	0/1670	0.68	0/2253
All	All	0.51	1/6676 (0.0%)	0.69	0/9006

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	C	167	MSE	SE-CE	-5.07	1.65	1.95

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

### 5.2 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 the 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 within the asymmetric unit, whereas Symm-Clashes lists symmetry-related clashes.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	1643	0	1615	10	0
1	B	1633	0	1593	13	0
1	C	1637	0	1604	8	0
1	D	1639	0	1604	7	0
All	All	6552	0	6416	37	0

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 3.

All (37) close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:68:ARG:NH2	1:B:113:ASP:OD1	2.34	0.59
1:A:166:VAL:HG12	1:A:167:MSE:HE2	1.87	0.57
1:D:166:VAL:HG12	1:D:167:MSE:HE2	1.87	0.56
1:B:148:PHE:HE2	1:B:154:ILE:HG12	1.71	0.55
1:A:161:LEU:HD23	1:A:165:MSE:HE2	1.90	0.53
1:C:166:VAL:HG12	1:C:167:MSE:HE2	1.90	0.53
1:B:166:VAL:HG12	1:B:167:MSE:HE2	1.90	0.52
1:B:149:LEU:HD22	1:B:161:LEU:HD12	1.92	0.52
1:B:134:PHE:HZ	1:B:186:GLY:HA2	1.77	0.50
1:B:119:MSE:O	1:B:123:SER:OG	2.28	0.49
1:D:152:THR:HG23	1:D:196:LYS:HD2	1.95	0.48
1:B:152:THR:HG23	1:B:196:LYS:HD2	1.96	0.48
1:B:58:ILE:HG12	1:B:61:VAL:HG23	1.96	0.48
1:D:119:MSE:O	1:D:123:SER:OG	2.31	0.48
1:C:152:THR:HG23	1:C:196:LYS:HD2	1.96	0.47
1:A:152:THR:HG23	1:A:196:LYS:HD2	1.97	0.46
1:A:85:GLY:HA3	1:A:209:GLN:HE22	1.82	0.45
1:C:119:MSE:O	1:C:123:SER:OG	2.31	0.45
1:D:107:LYS:HG2	1:D:119:MSE:HE1	1.98	0.45
1:A:119:MSE:O	1:A:123:SER:OG	2.30	0.44
1:D:149:LEU:HD22	1:D:161:LEU:HD12	2.00	0.44
1:C:68:ARG:NH2	1:C:113:ASP:OD1	2.51	0.44
1:C:107:LYS:HG2	1:C:119:MSE:HE1	2.00	0.43
1:D:134:PHE:HZ	1:D:186:GLY:HA2	1.83	0.43
1:A:107:LYS:HG2	1:A:119:MSE:HE1	1.99	0.43
1:C:55:LEU:HB3	1:C:61:VAL:HG11	2.01	0.43
1:C:52:VAL:HG11	1:C:113:ASP:HB3	2.01	0.42
1:A:121:TRP:O	1:A:125:HIS:HB3	2.19	0.42
1:B:107:LYS:HG2	1:B:119:MSE:HE1	2.00	0.42
1:C:121:TRP:O	1:C:125:HIS:HB3	2.20	0.42
1:D:138:VAL:O	1:D:142:ILE:HG12	2.20	0.42
1:A:74:PHE:HA	1:B:111:VAL:HG13	2.02	0.42
1:B:149:LEU:HD11	1:B:158:VAL:HG22	2.03	0.41
1:B:121:TRP:O	1:B:125:HIS:HB3	2.21	0.41
1:A:55:LEU:HB3	1:A:61:VAL:HG11	2.03	0.40
1:B:139:PHE:CZ	1:B:175:ASN:HB3	2.56	0.40
1:A:139:PHE:CZ	1:A:175:ASN:HB3	2.56	0.40

There are no symmetry-related clashes.



## 5.3 Torsion angles [i](#)

### 5.3.1 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 X-ray entries followed by that with respect to entries of similar resolution.

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	201/224 (90%)	198 (98%)	3 (2%)	0	100	100
1	B	201/224 (90%)	197 (98%)	4 (2%)	0	100	100
1	C	201/224 (90%)	197 (98%)	4 (2%)	0	100	100
1	D	201/224 (90%)	197 (98%)	4 (2%)	0	100	100
All	All	804/896 (90%)	789 (98%)	15 (2%)	0	100	100

There are no Ramachandran outliers to report.

### 5.3.2 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 X-ray entries followed by that with respect to entries of similar resolution.

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	173/185 (94%)	168 (97%)	5 (3%)	42	72
1	B	171/185 (92%)	167 (98%)	4 (2%)	50	78
1	C	172/185 (93%)	167 (97%)	5 (3%)	42	72
1	D	172/185 (93%)	167 (97%)	5 (3%)	42	72
All	All	688/740 (93%)	669 (97%)	19 (3%)	43	73

All (19) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	50	LEU
1	A	58	ILE

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Mol	Chain	Res	Type
1	A	123	SER
1	A	125	HIS
1	A	161	LEU
1	B	50	LEU
1	B	58	ILE
1	B	123	SER
1	B	125	HIS
1	C	47	MSE
1	C	58	ILE
1	C	123	SER
1	C	125	HIS
1	C	161	LEU
1	D	47	MSE
1	D	50	LEU
1	D	58	ILE
1	D	123	SER
1	D	125	HIS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (2) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	209	GLN
1	D	209	GLN

### 5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

### 5.4 Non-standard residues in protein, DNA, RNA chains [i](#)

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

### 5.5 Carbohydrates [i](#)

There are no monosaccharides in this entry.

### 5.6 Ligand geometry [i](#)

There are no ligands in this entry.

## 5.7 Other polymers [i](#)

There are no such residues in this entry.

## 5.8 Polymer linkage issues [i](#)

There are no chain breaks in this entry.

## 6 Fit of model and data

### 6.1 Protein, DNA and RNA chains

In the following table, the column labelled ‘#RSRZ > 2’ contains the number (and percentage) of RSRZ outliers, followed by percent RSRZ outliers for the chain as percentile scores relative to all X-ray entries and entries of similar resolution. The OWAB column contains the minimum, median, 95<sup>th</sup> percentile and maximum values of the occupancy-weighted average B-factor per residue. The column labelled ‘Q < 0.9’ lists the number of (and percentage) of residues with an average occupancy less than 0.9.

Mol	Chain	Analysed	<RSRZ>	#RSRZ>2	OWAB(Å <sup>2</sup> )	Q<0.9
1	A	200/224 (89%)	-0.04	3 (1%) 73 72	46, 61, 95, 116	0
1	B	200/224 (89%)	-0.01	3 (1%) 73 72	48, 66, 116, 136	0
1	C	200/224 (89%)	0.27	12 (6%) 21 17	41, 67, 120, 137	0
1	D	200/224 (89%)	0.40	14 (7%) 16 12	49, 83, 140, 161	0
All	All	800/896 (89%)	0.15	32 (4%) 38 32	41, 69, 123, 161	0

All (32) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	D	106	LYS	6.2
1	A	30	GLY	5.9
1	C	105	TYR	4.9
1	C	109	PRO	4.9
1	C	110	VAL	4.8
1	D	79	LEU	4.7
1	C	108	VAL	4.1
1	D	109	PRO	4.1
1	D	108	VAL	3.9
1	C	107	LYS	3.8
1	D	107	LYS	3.8
1	D	91	TYR	3.6
1	D	105	TYR	3.4
1	D	75	ASN	3.1
1	B	96	LYS	3.0
1	A	136	THR	2.8
1	D	76	LEU	2.8
1	C	104	PHE	2.7
1	B	79	LEU	2.7
1	A	31	ASN	2.6
1	C	202	TRP	2.4

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Mol	Chain	Res	Type	RSRZ
1	C	106	LYS	2.4
1	C	30	GLY	2.3
1	C	69	TRP	2.3
1	C	205	LEU	2.2
1	D	87	LEU	2.2
1	D	65	PHE	2.2
1	D	78	ASP	2.2
1	D	96	LYS	2.2
1	D	74	PHE	2.1
1	B	76	LEU	2.1
1	C	31	ASN	2.0

## 6.2 Non-standard residues in protein, DNA, RNA chains [i](#)

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

## 6.3 Carbohydrates [i](#)

There are no monosaccharides in this entry.

## 6.4 Ligands [i](#)

There are no ligands in this entry.

## 6.5 Other polymers [i](#)

There are no such residues in this entry.