Full wwPDB X-ray Structure Validation Report ⓘ

May 23, 2020 – 12:25 pm BST

PDB ID	:	3M9C
Title	:	Crystal structure of the membrane domain of respiratory complex I from Escherichia coli
Authors	:	Efremov, R.G.; Baradaran, R.; Sazanov, L.A.
Deposited on	:	2010-03-22
Resolution	:	3.90 Å(reported)

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

MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.13
EDS	:	2.11
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)	:	2.11

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 3.90 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	Percentile Ranks	Value
Clashscore		8

Worse   *Better*

▌Percentile relative to all X-ray structures

▯Percentile relative to X-ray structures of similar resolution
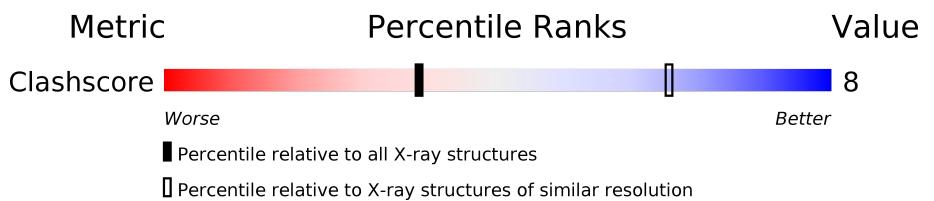
Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
Clashscore	141614	1004 (4.12-3.68)

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 on the lower bar indicate the fraction of residues that contain outliers for >=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 <=5%

Mol	Chain	Length	Quality of chain
1	L	474	96% ·
2	M	391	96% ·
3	N	378	97% ·
4	R	281	98% ·
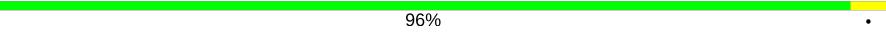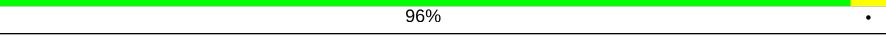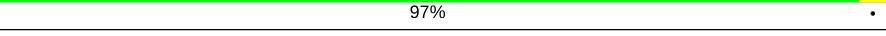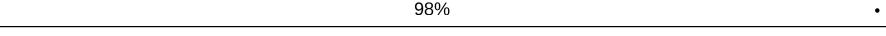
2 Entry composition (i)

There are 4 unique types of molecules in this entry. The entry contains 4572 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 NADH-quinone oxidoreductase subunit NuoL.

Mol	Chain	Residues	Atoms			ZeroOcc	AltConf	Trace
1	L	474	Total 1422	C 948	N 474	0	0	0

- Molecule 2 is a protein called NADH-quinone oxidoreductase subunit NuoM.

Mol	Chain	Residues	Atoms			ZeroOcc	AltConf	Trace
2	M	391	Total 1173	C 782	N 391	0	0	0

- Molecule 3 is a protein called NADH-quinone oxidoreductase subunit NuoN.

| Mol	Chain	Residues	Atoms			ZeroOcc	AltConf	Trace
3	N	378	Total 1134	C 756	N 378	0	0	0

- Molecule 4 is a protein called NADH-quinone oxidoreductase subunits NuoA,J and K.

| Mol	Chain	Residues	Atoms			ZeroOcc	AltConf	Trace
4	R	281	Total 843	C 562	N 281	0	0	0

3 Residue-property plots ⓘ

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry. Residues are color-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 outlier are shown as a green connector. Residues present in the sample, but not in the model, are shown in grey.

- Molecule 1: NADH-quinone oxidoreductase subunit NuoL

Chain L:

96%
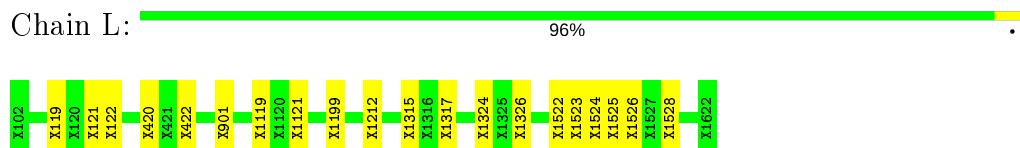
- Molecule 2: NADH-quinone oxidoreductase subunit NuoM

Chain M:

96%
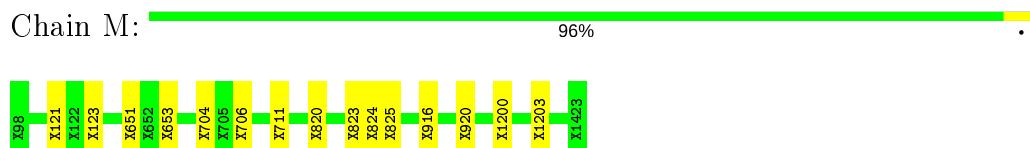
- Molecule 3: NADH-quinone oxidoreductase subunit NuoN

Chain N:

97%
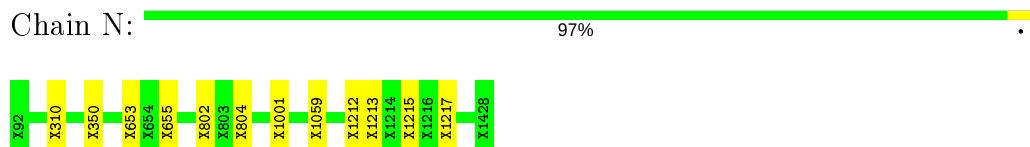
- Molecule 4: NADH-quinone oxidoreductase subunits NuoA,J and K

Chain R:

98%
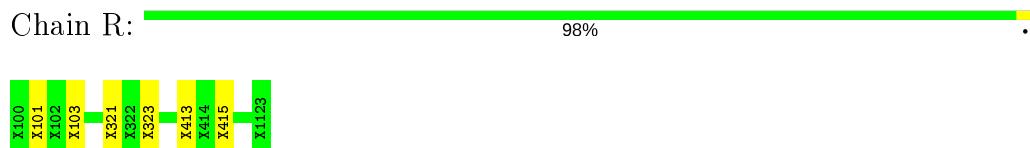
4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	114.06Å 182.17Å 185.60Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	30.00 – 3.90 29.96 – 3.90	Depositor EDS
% Data completeness (in resolution range)	(Not available) (30.00-3.90) 97.5 (29.96-3.90)	Depositor EDS
R_{merge}	0.20	Depositor
R_{sym}	(Not available)	Depositor
$<I/\sigma(I)>$ [1]	1.92 (at 3.86Å)	Xtriage
Refinement program		Depositor
R, R_{free}	(Not available) , (Not available) 0.457 , (Not available)	Depositor DCC
R_{free} test set	No test flags present.	wwPDB-VP
Wilson B-factor (Å^2)	108.5	Xtriage
Anisotropy	0.720	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	(Not available) , (Not available)	EDS
L-test for twinning[2]	$<|L|> = 0.35$, $<L^2> = 0.18$	Xtriage
Estimated twinning fraction	0.129 for -h,l,k	Xtriage
F_o,F_c correlation	0.65	EDS
Total number of atoms	4572	wwPDB-VP
Average B, all atoms (Å^2)	80.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.00% of the height of the origin peak. No significant pseudotranslation is detected.*

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[1]Intensities estimated from amplitudes.

[2]Theoretical values of $<|L|>$, $<L^2>$ 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).

There are no protein, RNA or DNA chains available to summarize Z scores of covalent bonds and angles.

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 outliers	#Planarity outliers
1	L	0	1

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	L	1212	UNK	Peptide

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	L	1422	0	52	10	0
2	M	1173	0	37	13	0
3	N	1134	0	36	10	0
4	R	843	0	24	3	0
All	All	4572	0	149	36	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 8.

All (36) 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)
3:N:1001:UNK:CA	3:N:1059:UNK:C	1.85	1.50
2:M:920:UNK:CA	2:M:1200:UNK:N	2.03	1.21
3:N:310:UNK:CA	3:N:350:UNK:CA	2.31	1.08
3:N:1001:UNK:C	3:N:1059:UNK:C	2.40	0.98
2:M:920:UNK:C	2:M:1200:UNK:H2	1.78	0.95
1:L:119:UNK:C	1:L:121:UNK:N	2.35	0.84
2:M:704:UNK:C	2:M:706:UNK:N	2.40	0.83
2:M:920:UNK:CA	2:M:1200:UNK:H2	1.77	0.83
1:L:420:UNK:C	1:L:422:UNK:N	2.44	0.75
1:L:1526:UNK:C	1:L:1528:UNK:N	2.48	0.74
3:N:310:UNK:CA	3:N:350:UNK:N	2.51	0.73
2:M:651:UNK:C	2:M:653:UNK:N	2.50	0.71
3:N:653:UNK:C	3:N:655:UNK:N	2.51	0.70
2:M:820:UNK:C	2:M:824:UNK:N	2.55	0.70
1:L:1522:UNK:C	1:L:1524:UNK:N	2.54	0.70
4:R:413:UNK:C	4:R:415:UNK:N	2.54	0.68
4:R:101:UNK:C	4:R:103:UNK:N	2.59	0.65
2:M:820:UNK:C	2:M:824:UNK:CA	2.80	0.59
1:L:1324:UNK:C	1:L:1326:UNK:N	2.63	0.58
3:N:802:UNK:C	3:N:804:UNK:N	2.65	0.58
1:L:1315:UNK:C	1:L:1317:UNK:N	2.67	0.57
2:M:121:UNK:C	2:M:123:UNK:N	2.66	0.57
3:N:310:UNK:CA	3:N:350:UNK:H2	2.19	0.56
2:M:920:UNK:CA	2:M:1200:UNK:H	2.11	0.55
2:M:920:UNK:C	2:M:1200:UNK:N	2.52	0.55
1:L:1119:UNK:C	1:L:1121:UNK:N	2.72	0.51
4:R:321:UNK:C	4:R:323:UNK:N	2.70	0.49
1:L:901:UNK:CA	1:L:1199:UNK:CA	2.91	0.49
3:N:1001:UNK:CA	3:N:1059:UNK:CA	2.81	0.49
3:N:1212:UNK:N	3:N:1213:UNK:CA	2.75	0.49
2:M:653:UNK:CA	2:M:711:UNK:CA	2.92	0.47
1:L:1523:UNK:C	1:L:1525:UNK:N	2.72	0.45
2:M:823:UNK:C	2:M:825:UNK:N	2.77	0.43
1:L:119:UNK:C	1:L:122:UNK:N	2.83	0.42
2:M:916:UNK:C	2:M:1203:UNK:CA	2.98	0.41
3:N:1215:UNK:C	3:N:1217:UNK:N	2.83	0.40

There are no symmetry-related clashes.

5.3 Torsion angles (i)

5.3.1 Protein backbone (i)

There are no protein backbone outliers to report in this entry.

5.3.2 Protein sidechains (i)

There are no protein residues with a non-rotameric sidechain to report in this entry.

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 carbohydrates 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)

The following chains have linkage breaks:

Mol	Chain	Number of breaks
1	L	20
3	N	16
2	M	16
4	R	10

All chain breaks are listed below:

Model	Chain	Residue-1	Atom-1	Residue-2	Atom-2	Distance (Å)
1	L	428:UNK	C	495:UNK	N	56.90
1	M	1024:UNK	C	1050:UNK	N	55.04
1	N	366:UNK	C	395:UNK	N	50.88
1	L	1417:UNK	C	1501:UNK	N	47.71
1	N	665:UNK	C	700:UNK	N	47.65
1	N	524:UNK	C	601:UNK	N	47.16
1	L	1326:UNK	C	1401:UNK	N	46.61
1	N	428:UNK	C	501:UNK	N	46.47
1	R	725:UNK	C	797:UNK	N	45.46
1	M	1328:UNK	C	1399:UNK	N	43.88
1	M	829:UNK	C	899:UNK	N	43.18
1	N	1222:UNK	C	1295:UNK	N	42.97
1	M	520:UNK	C	601:UNK	N	42.94
1	R	824:UNK	C	900:UNK	N	41.53
1	N	923:UNK	C	1001:UNK	N	41.07
1	R	524:UNK	C	603:UNK	N	40.88
1	L	1022:UNK	C	1050:UNK	N	40.59
1	L	520:UNK	C	601:UNK	N	40.17
1	M	228:UNK	C	301:UNK	N	39.55
1	L	922:UNK	C	1003:UNK	N	39.30
1	N	1059:UNK	C	1096:UNK	N	38.87
1	R	624:UNK	C	702:UNK	N	37.28
1	N	226:UNK	C	301:UNK	N	37.24
1	L	229:UNK	C	301:UNK	N	36.09
1	N	1022:UNK	C	1050:UNK	N	35.98
1	M	923:UNK	C	1002:UNK	N	34.04
1	L	360:UNK	C	401:UNK	N	33.91
1	N	723:UNK	C	801:UNK	N	33.47
1	M	1065:UNK	C	1100:UNK	N	30.93
1	N	121:UNK	C	202:UNK	N	29.63
1	M	123:UNK	C	201:UNK	N	28.64
1	L	1061:UNK	C	1101:UNK	N	28.15
1	M	424:UNK	C	495:UNK	N	16.18
1	L	824:UNK	C	901:UNK	N	15.99
1	M	367:UNK	C	398:UNK	N	15.97
1	L	666:UNK	C	704:UNK	N	15.22
1	M	1121:UNK	C	1200:UNK	N	14.32
1	L	732:UNK	C	802:UNK	N	14.14
1	N	823:UNK	C	903:UNK	N	13.62
1	M	734:UNK	C	800:UNK	N	12.90
1	R	919:UNK	C	997:UNK	N	12.22
1	R	125:UNK	C	202:UNK	N	11.40

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Model	Chain	Residue-1	Atom-1	Residue-2	Atom-2	Distance (Å)
1	M	1222:UNK	C	1300:UNK	N	11.26
1	L	613:UNK	C	650:UNK	N	11.20
1	N	1122:UNK	C	1200:UNK	N	11.16
1	N	1320:UNK	C	1401:UNK	N	11.09
1	R	423:UNK	C	494:UNK	N	10.86
1	M	663:UNK	C	704:UNK	N	10.34
1	N	615:UNK	C	650:UNK	N	10.27
1	L	1123:UNK	C	1195:UNK	N	9.83
1	L	127:UNK	C	201:UNK	N	9.74
1	R	324:UNK	C	397:UNK	N	9.72
1	M	615:UNK	C	650:UNK	N	9.60
1	L	1218:UNK	C	1298:UNK	N	9.44
1	R	223:UNK	C	295:UNK	N	8.96
1	L	311:UNK	C	350:UNK	N	6.99
1	N	313:UNK	C	350:UNK	N	6.87
1	R	1021:UNK	C	1098:UNK	N	6.64
1	M	313:UNK	C	350:UNK	N	5.71
1	L	1597:UNK	C	1601:UNK	N	4.80
1	L	1543:UNK	C	1545:UNK	N	4.39
1	L	1564:UNK	C	1566:UNK	N	3.11

6 Fit of model and data (i)

6.1 Protein, DNA and RNA chains (i)

Unable to reproduce the depositors R factor - this section is therefore empty.

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

Unable to reproduce the depositors R factor - this section is therefore empty.

6.3 Carbohydrates (i)

Unable to reproduce the depositors R factor - this section is therefore empty.

6.4 Ligands (i)

Unable to reproduce the depositors R factor - this section is therefore empty.

6.5 Other polymers (i)

Unable to reproduce the depositors R factor - this section is therefore empty.