



# wwPDB X-ray Structure Validation Summary Report ⓘ

Feb 1, 2016 – 07:04 PM GMT

PDB ID : 4NNU  
Title : Distinct structural features of TFAM drive mitochondrial DNA packaging versus transcriptional activation  
Authors : Ngo, H.B.; Lovely, G.A.; Phillips, R.; Chan, D.C.  
Deposited on : 2013-11-19  
Resolution : 2.81 Å(reported)

This is a wwPDB X-ray Structure Validation Summary 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/XrayValidationReportHelp>  
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  
Mogul : 1.7 (RC4), CSD as536be (2015)  
Xtriage (Phenix) : 1.9-1692  
EDS : rb-20026688  
Percentile statistics : 20151230.v01 (using entries in the PDB archive December 30th 2015)  
Refmac : 5.8.0135  
CCP4 : 6.5.0  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : trunk26865

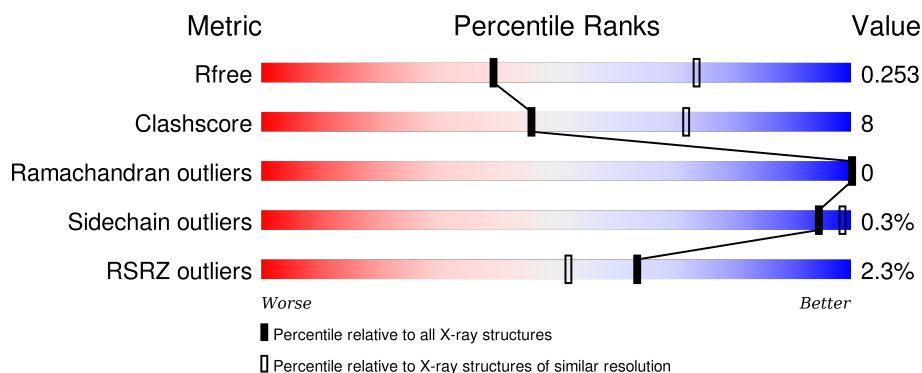
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 2.81 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))
$R_{free}$	91344	2676 (2.84-2.80)
Clashscore	102246	3124 (2.84-2.80)
Ramachandran outliers	100387	3072 (2.84-2.80)
Sidechain outliers	100360	3074 (2.84-2.80)
RSRZ outliers	91569	2690 (2.84-2.80)

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  $\geq 3$ , 2, 1 and 0 types of geometric quality criteria. 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	230	<div> <div>72%</div> <div>11%</div> <div>16%</div> </div>
1	B	230	<div> <div>3%</div> <div>71%</div> <div>11%</div> <div>17%</div> </div>
2	C	22	<div> <div>5%</div> <div>23%</div> <div>55%</div> <div>23%</div> </div>
2	E	22	<div> <div>36%</div> <div>32%</div> <div>32%</div> </div>
3	D	22	<div> <div>50%</div> <div>36%</div> <div>14%</div> </div>

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Mol	Chain	Length	Quality of chain
3	F	22	<div><div></div><div>5%</div><div>32%</div><div>64%</div><div>5%</div></div>

## 2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 5077 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 Transcription factor A, mitochondrial.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	193	Total	C	N	O	S	0	0	0
			1626	1028	293	299	6			
1	B	192	Total	C	N	O	S	0	0	0
			1617	1022	291	298	6			

There are 70 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	8	MET	-	EXPRESSION TAG	UNP Q00059
A	9	GLY	-	EXPRESSION TAG	UNP Q00059
A	10	SER	-	EXPRESSION TAG	UNP Q00059
A	11	SER	-	EXPRESSION TAG	UNP Q00059
A	12	HIS	-	EXPRESSION TAG	UNP Q00059
A	13	HIS	-	EXPRESSION TAG	UNP Q00059
A	14	HIS	-	EXPRESSION TAG	UNP Q00059
A	15	HIS	-	EXPRESSION TAG	UNP Q00059
A	16	HIS	-	EXPRESSION TAG	UNP Q00059
A	17	HIS	-	EXPRESSION TAG	UNP Q00059
A	18	SER	-	EXPRESSION TAG	UNP Q00059
A	19	SER	-	EXPRESSION TAG	UNP Q00059
A	20	GLY	-	EXPRESSION TAG	UNP Q00059
A	21	LEU	-	EXPRESSION TAG	UNP Q00059
A	22	VAL	-	EXPRESSION TAG	UNP Q00059
A	23	PRO	-	EXPRESSION TAG	UNP Q00059
A	24	ARG	-	EXPRESSION TAG	UNP Q00059
A	25	GLY	-	EXPRESSION TAG	UNP Q00059
A	26	SER	-	EXPRESSION TAG	UNP Q00059
A	27	HIS	-	EXPRESSION TAG	UNP Q00059
A	28	MET	-	EXPRESSION TAG	UNP Q00059
A	29	ALA	-	EXPRESSION TAG	UNP Q00059
A	30	SER	-	EXPRESSION TAG	UNP Q00059
A	31	MET	-	EXPRESSION TAG	UNP Q00059
A	32	THR	-	EXPRESSION TAG	UNP Q00059

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Chain	Residue	Modelled	Actual	Comment	Reference
A	33	GLY	-	EXPRESSION TAG	UNP Q00059
A	34	GLY	-	EXPRESSION TAG	UNP Q00059
A	35	GLN	-	EXPRESSION TAG	UNP Q00059
A	36	GLN	-	EXPRESSION TAG	UNP Q00059
A	37	MET	-	EXPRESSION TAG	UNP Q00059
A	38	GLY	-	EXPRESSION TAG	UNP Q00059
A	39	ARG	-	EXPRESSION TAG	UNP Q00059
A	40	GLY	-	EXPRESSION TAG	UNP Q00059
A	41	SER	-	EXPRESSION TAG	UNP Q00059
A	42	MET	-	EXPRESSION TAG	UNP Q00059
B	8	MET	-	EXPRESSION TAG	UNP Q00059
B	9	GLY	-	EXPRESSION TAG	UNP Q00059
B	10	SER	-	EXPRESSION TAG	UNP Q00059
B	11	SER	-	EXPRESSION TAG	UNP Q00059
B	12	HIS	-	EXPRESSION TAG	UNP Q00059
B	13	HIS	-	EXPRESSION TAG	UNP Q00059
B	14	HIS	-	EXPRESSION TAG	UNP Q00059
B	15	HIS	-	EXPRESSION TAG	UNP Q00059
B	16	HIS	-	EXPRESSION TAG	UNP Q00059
B	17	HIS	-	EXPRESSION TAG	UNP Q00059
B	18	SER	-	EXPRESSION TAG	UNP Q00059
B	19	SER	-	EXPRESSION TAG	UNP Q00059
B	20	GLY	-	EXPRESSION TAG	UNP Q00059
B	21	LEU	-	EXPRESSION TAG	UNP Q00059
B	22	VAL	-	EXPRESSION TAG	UNP Q00059
B	23	PRO	-	EXPRESSION TAG	UNP Q00059
B	24	ARG	-	EXPRESSION TAG	UNP Q00059
B	25	GLY	-	EXPRESSION TAG	UNP Q00059
B	26	SER	-	EXPRESSION TAG	UNP Q00059
B	27	HIS	-	EXPRESSION TAG	UNP Q00059
B	28	MET	-	EXPRESSION TAG	UNP Q00059
B	29	ALA	-	EXPRESSION TAG	UNP Q00059
B	30	SER	-	EXPRESSION TAG	UNP Q00059
B	31	MET	-	EXPRESSION TAG	UNP Q00059
B	32	THR	-	EXPRESSION TAG	UNP Q00059
B	33	GLY	-	EXPRESSION TAG	UNP Q00059
B	34	GLY	-	EXPRESSION TAG	UNP Q00059
B	35	GLN	-	EXPRESSION TAG	UNP Q00059
B	36	GLN	-	EXPRESSION TAG	UNP Q00059
B	37	MET	-	EXPRESSION TAG	UNP Q00059
B	38	GLY	-	EXPRESSION TAG	UNP Q00059
B	39	ARG	-	EXPRESSION TAG	UNP Q00059

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Chain	Residue	Modelled	Actual	Comment	Reference
B	40	GLY	-	EXPRESSION TAG	UNP Q00059
B	41	SER	-	EXPRESSION TAG	UNP Q00059
B	42	MET	-	EXPRESSION TAG	UNP Q00059

- Molecule 2 is a DNA chain called DNA1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	C	22	Total 456	C 216	N 84	O 134	P 22	0	0	0
2	E	22	Total 456	C 216	N 84	O 134	P 22	0	0	0

- Molecule 3 is a DNA chain called DNA2.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	D	22	Total 446	C 212	N 82	O 130	P 22	0	0	0
3	F	22	Total 446	C 212	N 82	O 130	P 22	0	0	0

- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	13	Total 13	O 13	0	0
4	B	6	Total 6	O 6	0	0
4	C	4	Total 4	O 4	0	0
4	E	1	Total 1	O 1	0	0
4	D	1	Total 1	O 1	0	0
4	F	5	Total 5	O 5	0	0

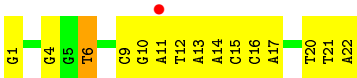


- Molecule 1: Transcription factor A, mitochondrial





● Molecule 3: DNA2





## 4 Data and refinement statistics

Property	Value	Source
Space group	I 2 2 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	109.80Å 114.38Å 144.59Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	36.02 – 2.81 36.02 – 2.81	Depositor EDS
% Data completeness (in resolution range)	97.4 (36.02-2.81) 93.0 (36.02-2.81)	Depositor EDS
$R_{merge}$	0.08	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.06 (at 2.81Å)	Xtriage
Refinement program	PHENIX (phenix.refine: 1.7.3_928)	Depositor
R, $R_{free}$	0.214 , 0.261 0.206 , 0.253	Depositor DCC
$R_{free}$ test set	1904 reflections (9.08%)	DCC
Wilson B-factor (Å <sup>2</sup> )	62.1	Xtriage
Anisotropy	0.210	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.30 , 48.1	EDS
Estimated twinning fraction	0.013 for -k,-h,-l	Xtriage
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.47$ , $\langle L^2 \rangle = 0.30$	Xtriage
Outliers	0 of 22010 reflections	Xtriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	5077	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	82.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 14.87% 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, 0.375 respectively for untwinned datasets, and 0.333, 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	0.31	0/1657	0.58	1/2216 (0.0%)
1	B	0.30	0/1648	0.57	1/2205 (0.0%)
2	C	0.66	0/511	1.67	13/788 (1.6%)
2	E	0.69	0/511	1.74	12/788 (1.5%)
3	D	0.73	0/499	1.54	13/766 (1.7%)
3	F	0.73	0/499	1.64	11/766 (1.4%)
All	All	0.50	0/5325	1.15	51/7529 (0.7%)

There are no bond length outliers.

The worst 5 of 51 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	E	16	DG	O4'-C1'-N9	12.95	117.07	108.00
2	E	10	DT	O4'-C1'-N1	10.75	115.52	108.00
2	C	9	DT	O4'-C1'-N1	9.91	114.94	108.00
3	F	22	DA	C3'-C2'-C1'	-9.60	90.98	102.50
2	E	11	DA	O4'-C1'-N9	9.41	114.58	108.00

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	1626	0	1674	18	0
1	B	1617	0	1661	18	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	C	456	0	249	13	0
2	E	456	0	249	9	0
3	D	446	0	247	8	0
3	F	446	0	247	10	0
4	A	13	0	0	2	0
4	B	6	0	0	0	0
4	C	4	0	0	1	0
4	D	1	0	0	0	0
4	E	1	0	0	0	0
4	F	5	0	0	0	0
All	All	5077	0	4327	62	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.

The worst 5 of 62 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)
2:C:14:DG:H1	3:D:9:DC:H42	1.26	0.83
1:A:44:SER:OG	4:A:312:HOH:O	2.05	0.73
3:D:15:DC:H2'	3:D:16:DC:C6	2.30	0.65
2:C:13:DC:H2''	2:C:14:DG:C8	2.32	0.65
2:E:8:DG:N2	3:F:15:DC:O2	2.31	0.62

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	191/230 (83%)	186 (97%)	5 (3%)	0	100	100
1	B	190/230 (83%)	185 (97%)	5 (3%)	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
All	All	381/460 (83%)	371 (97%)	10 (3%)	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	179/208 (86%)	179 (100%)	0	100	100
1	B	178/208 (86%)	177 (99%)	1 (1%)	90	97
All	All	357/416 (86%)	356 (100%)	1 (0%)	94	98

All (1) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	58	LEU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

### 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](#)

There are no chain breaks in this entry.

## 6 Fit of model and data [i](#)

### 6.1 Protein, DNA and RNA chains [i](#)

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	193/230 (83%)	0.03	3 (1%) 74 65	34, 63, 117, 156	0
1	B	192/230 (83%)	0.14	6 (3%) 52 40	37, 73, 135, 178	0
2	C	22/22 (100%)	0.41	1 (4%) 37 26	58, 74, 150, 164	0
2	E	22/22 (100%)	0.31	0 100 100	60, 89, 145, 154	0
3	D	22/22 (100%)	-0.09	0 100 100	49, 76, 126, 139	0
3	F	22/22 (100%)	0.38	1 (4%) 37 26	51, 95, 162, 172	0
All	All	473/548 (86%)	0.12	11 (2%) 64 52	34, 69, 138, 178	0

The worst 5 of 11 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	176	ASP	3.6
1	A	174	LYS	3.1
3	F	11	DA	3.1
1	B	174	LYS	3.0
2	C	8	DG	2.8

### 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 carbohydrates 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.