



# wwPDB X-ray Structure Validation Summary Report ⓘ

May 29, 2020 – 04:46 am BST

PDB ID : 4FBW  
Title : Crystal structure of an unfused Mre11-Nbs1 complex with two manganese ions per active site  
Authors : Schiller, C.B.; Lammens, K.; Hopfner, K.P.  
Deposited on : 2012-05-23  
Resolution : 2.20 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

<https://www.wwpdb.org/validation/2017/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
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

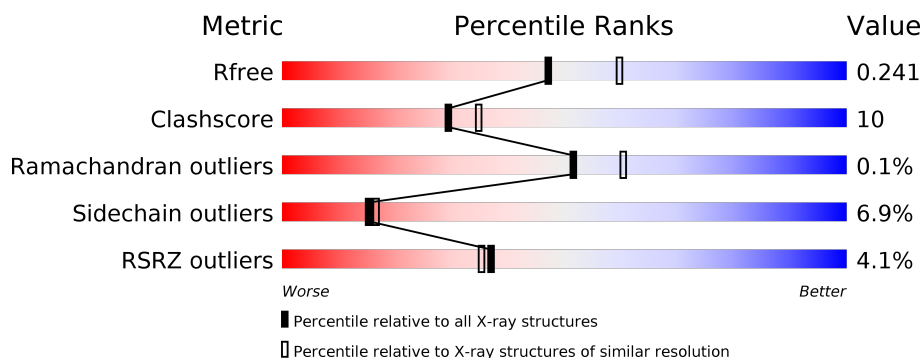
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.20 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	4898 (2.20-2.20)
Clashscore	141614	5594 (2.20-2.20)
Ramachandran outliers	138981	5503 (2.20-2.20)
Sidechain outliers	138945	5504 (2.20-2.20)
RSRZ outliers	127900	4800 (2.20-2.20)

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 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	417	<div> <div>3%</div> <div>74%</div> <div>16%</div> <div>9%</div> </div>
1	B	417	<div> <div>%</div> <div>76%</div> <div>15%</div> <div>7%</div> </div>
2	C	59	<div> <div>17%</div> <div>22%</div> <div>7%</div> <div>5%</div> <div>64%</div> </div>
2	D	59	<div> <div>5%</div> <div>20%</div> <div>73%</div> </div>

## 2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 6703 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 DNA repair protein rad32.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	379	Total	C	N	O	S	83	0	0
			3056	1953	527	569	7			
1	B	386	Total	C	N	O	S	70	0	0
			3107	1981	535	583	8			

There are 20 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	5	GLY	-	EXPRESSION TAG	UNP Q09683
A	6	PRO	-	EXPRESSION TAG	UNP Q09683
A	414	VAL	-	CLONING ARTIFACT	UNP Q09683
A	415	ASP	-	CLONING ARTIFACT	UNP Q09683
A	416	GLU	-	CLONING ARTIFACT	UNP Q09683
A	417	ASN	-	CLONING ARTIFACT	UNP Q09683
A	418	LEU	-	CLONING ARTIFACT	UNP Q09683
A	419	TYR	-	CLONING ARTIFACT	UNP Q09683
A	420	PHE	-	CLONING ARTIFACT	UNP Q09683
A	421	GLN	-	CLONING ARTIFACT	UNP Q09683
B	5	GLY	-	EXPRESSION TAG	UNP Q09683
B	6	PRO	-	EXPRESSION TAG	UNP Q09683
B	414	VAL	-	CLONING ARTIFACT	UNP Q09683
B	415	ASP	-	CLONING ARTIFACT	UNP Q09683
B	416	GLU	-	CLONING ARTIFACT	UNP Q09683
B	417	ASN	-	CLONING ARTIFACT	UNP Q09683
B	418	LEU	-	CLONING ARTIFACT	UNP Q09683
B	419	TYR	-	CLONING ARTIFACT	UNP Q09683
B	420	PHE	-	CLONING ARTIFACT	UNP Q09683
B	421	GLN	-	CLONING ARTIFACT	UNP Q09683

- Molecule 2 is a protein called DNA repair and telomere maintenance protein nbs1.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
2	C	21	Total	C	N	O	35	0	0
			188	119	40	29			
2	D	16	Total	C	N	O	29	0	0
			140	84	30	26			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
C	473	GLY	-	CLONING ARTIFACT	UNP O43070
D	473	GLY	-	CLONING ARTIFACT	UNP O43070

- Molecule 3 is MANGANESE (II) ION (three-letter code: MN) (formula: Mn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	B	2	Total	Mn	0	0
			2	2		
3	A	2	Total	Mn	0	0
			2	2		

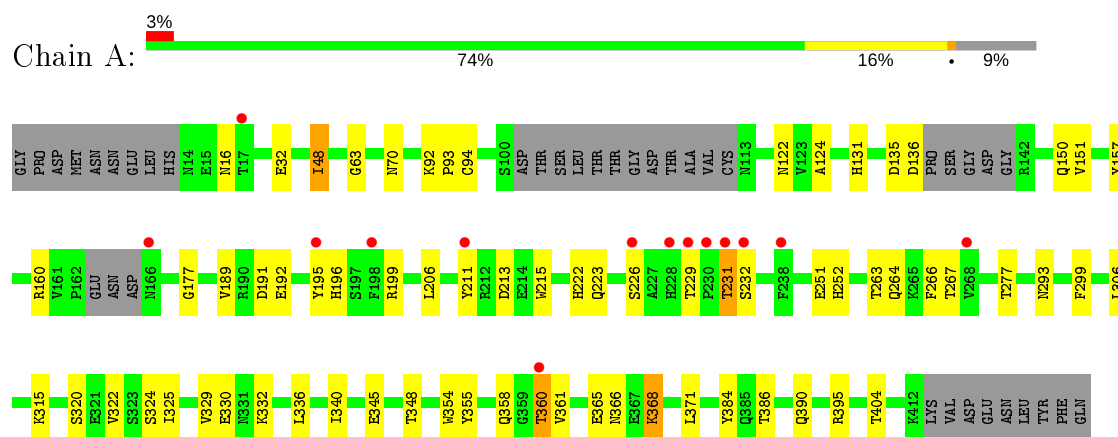
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	92	Total	O	0	0
			92	92		
4	B	115	Total	O	0	0
			115	115		
4	C	1	Total	O	0	0
			1	1		

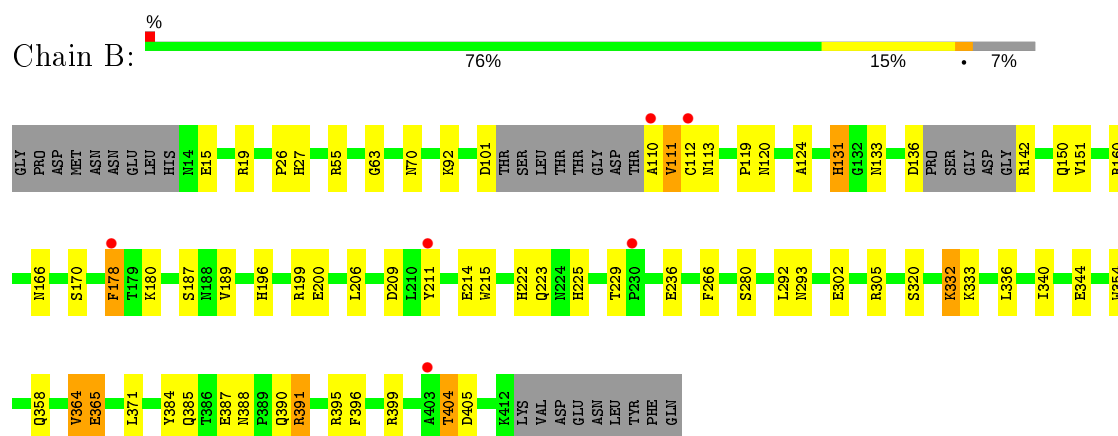
### 3 Residue-property plots [i](#)

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 and electron density. 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. A red dot above a residue indicates a poor fit to the electron density ( $RSRZ > 2$ ). 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.

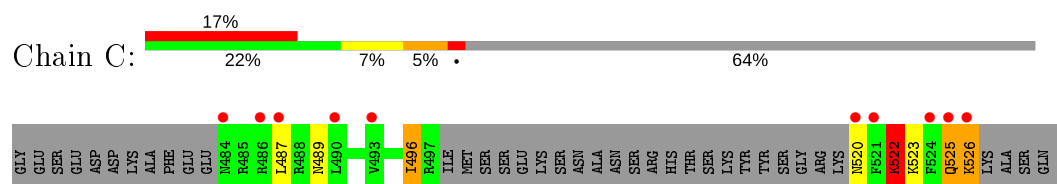
- Molecule 1: DNA repair protein rad32



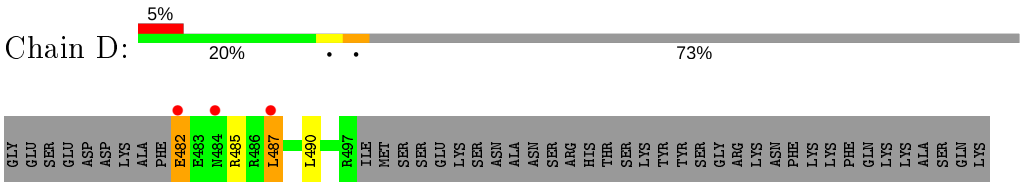
- Molecule 1: DNA repair protein rad32



- Molecule 2: DNA repair and telomere maintenance protein nbs1



- Molecule 2: DNA repair and telomere maintenance protein nbs1



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	59.12Å 79.95Å 220.93Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	47.54 – 2.20 47.54 – 2.20	Depositor EDS
% Data completeness (in resolution range)	99.4 (47.54-2.20) 99.4 (47.54-2.20)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.34 (at 2.20Å)	Xtriage
Refinement program	PHENIX (phenix.refine: 1.7.3_928)	Depositor
R, $R_{free}$	0.233 , 0.244 0.228 , 0.241	Depositor DCC
$R_{free}$ test set	2000 reflections (3.71%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	38.8	Xtriage
Anisotropy	0.201	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.33 , 38.5	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.93	EDS
Total number of atoms	6703	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	50.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.78% 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](#)

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

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	0.49	0/3127	0.69	1/4247 (0.0%)
1	B	0.50	0/3179	0.69	3/4320 (0.1%)
2	C	0.47	0/189	0.84	2/246 (0.8%)
2	D	0.44	0/140	0.60	0/185
All	All	0.49	0/6635	0.69	6/8998 (0.1%)

There are no bond length outliers.

The worst 5 of 6 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	26	PRO	C-N-CA	-8.72	99.91	121.70
1	B	113	ASN	CB-CA-C	7.66	125.72	110.40
2	C	522	LYS	CB-CA-C	-6.33	97.75	110.40
2	C	523	LYS	N-CA-CB	-5.39	100.89	110.60
1	A	213	ASP	CB-CG-OD2	5.24	123.02	118.30

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	3056	0	3026	61	0
1	B	3107	0	3066	45	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	C	188	0	198	15	0
2	D	140	0	140	4	0
3	A	2	0	0	0	0
3	B	2	0	0	0	0
4	A	92	0	0	1	0
4	B	115	0	0	0	0
4	C	1	0	0	0	0
All	All	6703	0	6430	118	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 10.

The worst 5 of 118 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:110:ALA:O	1:B:111:VAL:HG22	1.29	1.24
1:A:195:TYR:CD2	1:A:231:THR:CG2	2.26	1.19
1:A:195:TYR:CD2	1:A:231:THR:HG22	1.78	1.17
2:C:525:GLN:O	2:C:526:LYS:HB2	1.46	1.13
1:A:195:TYR:CE2	1:A:231:THR:HG23	1.83	1.13

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	371/417 (89%)	358 (96%)	13 (4%)	0	100	100
1	B	380/417 (91%)	362 (95%)	17 (4%)	1 (0%)	41	46
2	C	17/59 (29%)	15 (88%)	2 (12%)	0	100	100
2	D	14/59 (24%)	13 (93%)	1 (7%)	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles
All	All	782/952 (82%)	748 (96%)	33 (4%)	1 (0%)	51 60

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	111	VAL

### 5.3.2 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 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	343/376 (91%)	325 (95%)	18 (5%)	23 28
1	B	349/376 (93%)	325 (93%)	24 (7%)	15 16
2	C	20/53 (38%)	15 (75%)	5 (25%)	0 0
2	D	15/53 (28%)	12 (80%)	3 (20%)	1 1
All	All	727/858 (85%)	677 (93%)	50 (7%)	15 16

5 of 50 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	142	ARG
1	B	209	ASP
2	C	526	LYS
1	B	151	VAL
1	B	178	PHE

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 20 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	70	ASN
1	B	120	ASN
1	B	388	ASN
1	A	390	GLN

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Mol	Chain	Res	Type
1	A	394	ASN

### 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](#)

Of 4 ligands modelled in this entry, 4 are monoatomic - leaving 0 for Mogul analysis.

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

### 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	379/417 (90%)	0.07	14 (3%) 41 39	24, 46, 85, 116	21 (5%)
1	B	386/417 (92%)	-0.04	6 (1%) 72 70	25, 41, 78, 116	19 (4%)
2	C	21/59 (35%)	2.13	10 (47%) 0 0	69, 84, 101, 105	7 (33%)
2	D	16/59 (27%)	0.89	3 (18%) 1 1	69, 89, 107, 140	6 (37%)
All	All	802/952 (84%)	0.09	33 (4%) 37 35	24, 44, 89, 140	53 (6%)

The worst 5 of 33 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	C	521	PHE	7.0
2	C	520	ASN	5.3
1	A	230	PRO	5.2
2	D	482	GLU	5.1
2	C	486	ARG	4.2

### 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](#)

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95<sup>th</sup> percentile and maximum values of B factors of atoms in the group. The column labelled ‘Q< 0.9’ lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors( $\text{\AA}^2$ )	Q<0.9
3	MN	B	502	1/1	0.95	0.21	34,34,34,34	0
3	MN	A	501	1/1	0.96	0.10	45,45,45,45	0
3	MN	B	501	1/1	0.98	0.19	40,40,40,40	0
3	MN	A	502	1/1	0.99	0.16	40,40,40,40	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.