



# Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 09:21 PM UTC

PDB ID : 3ESF / pdb\_00003esf  
Title : Crystal Structure of the enzyme Fe-superoxide dismutase TbSODB2 from Trypanosoma brucei  
Authors : Bachega, J.F.R.; Navarro, M.V.A.S.; Garratt, R.C.  
Deposited on : 2008-10-05  
Resolution : 2.01 Å(reported)

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<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	:	4-5-2 with Phenix2.0
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

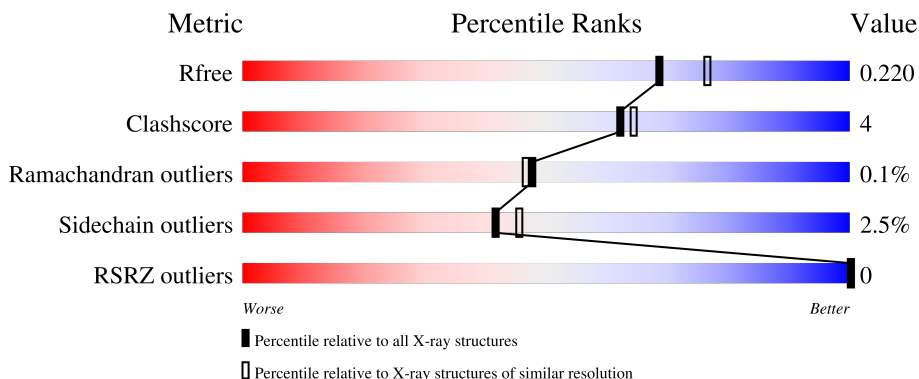
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*





The reported resolution of this entry is 2.01 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))
$R_{free}$	180053	10052 (2.00-2.00)
Clashscore	190562	11152 (2.00-2.00)
Ramachandran outliers	187476	11031 (2.00-2.00)
Sidechain outliers	187428	11029 (2.00-2.00)
RSRZ outliers	180081	10067 (2.00-2.00)

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	197	 92% 7% ..
1	B	197	 92% 8% .
1	C	197	 86% 12% .
1	D	197	 90% 8% .

## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 7014 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 Iron-containing superoxide dismutase B2.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	197	Total	C	N	O	S	0	0	0
			1568	1012	264	287	5			
1	B	197	Total	C	N	O	S	0	3	0
			1594	1027	269	293	5			
1	C	197	Total	C	N	O	S	0	0	0
			1568	1012	264	287	5			
1	D	197	Total	C	N	O	S	0	1	0
			1574	1016	264	289	5			

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	159	THR	ALA	engineered mutation	UNP Q2KN30
B	159	THR	ALA	engineered mutation	UNP Q2KN30
C	159	THR	ALA	engineered mutation	UNP Q2KN30
D	159	THR	ALA	engineered mutation	UNP Q2KN30

- Molecule 2 is FE (III) ION (CCD ID: FE) (formula: Fe).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	1	Total	Fe	0	0
			1	1		
2	B	1	Total	Fe	0	0
			1	1		
2	C	1	Total	Fe	0	0
			1	1		
2	D	1	Total	Fe	0	0
			1	1		


- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	169	Total 169	O 169	0	0
3	B	197	Total 197	O 197	0	0
3	C	193	Total 193	O 193	0	0
3	D	147	Total 147	O 147	0	0

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


These plots are drawn for all protein, RNA, DNA and oligosaccharide 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.

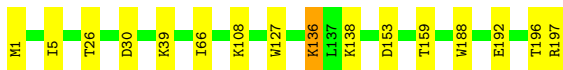
- Molecule 1: Iron-containing superoxide dismutase B2

Chain A:  92% 7% ..




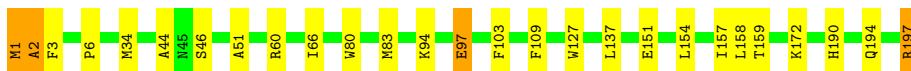
- Molecule 1: Iron-containing superoxide dismutase B2

Chain B:  92% 8% .




- Molecule 1: Iron-containing superoxide dismutase B2

Chain C:  86% 12% .



- Molecule 1: Iron-containing superoxide dismutase B2

Chain D:  90% 8% .



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	68.30Å 76.50Å 76.98Å 90.00° 92.70° 90.00°	Depositor
Resolution (Å)	30.18 – 2.01 30.18 – 2.01	Depositor EDS
% Data completeness (in resolution range)	99.4 (30.18-2.01) 99.7 (30.18-2.01)	Depositor EDS
$R_{merge}$	0.08	Depositor
$R_{sym}$	0.08	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.86 (at 2.01Å)	Xtriage
Refinement program	REFMAC 5.2.0019	Depositor
R, $R_{free}$	0.175 , 0.219 0.176 , 0.220	Depositor DCC
$R_{free}$ test set	2666 reflections (5.03%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	20.6	Xtriage
Anisotropy	0.081	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.36 , 30.0	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.45$ , $\langle L^2 \rangle = 0.28$	Xtriage
Estimated twinning fraction	0.057 for -h,l,k 0.167 for -h,-l,-k 0.084 for h,-k,-l	Xtriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	7014	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	20.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.21% 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

### 5.1 Standard geometry

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

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	0.83	0/1620	0.90	1/2204 (0.0%)
1	B	0.85	0/1649	0.92	0/2242
1	C	0.85	0/1620	1.00	5/2204 (0.2%)
1	D	0.77	0/1629	0.97	4/2216 (0.2%)
All	All	0.83	0/6518	0.95	10/8866 (0.1%)

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	A	0	1
1	B	0	1
1	C	0	2
1	D	0	3
All	All	0	7

There are no bond length outliers.

All (10) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	2	ALA	N-CA-C	-13.79	94.83	112.90
1	D	2	ALA	N-CA-C	-12.38	98.65	113.88
1	D	153	ASP	N-CA-C	-10.60	98.48	114.16
1	C	172	LYS	CB-CA-C	-6.38	109.20	116.54
1	D	158	LEU	CA-CB-CG	6.29	138.30	116.30
1	D	157	ILE	N-CA-C	-5.80	107.25	112.12
1	C	3	PHE	N-CA-CB	5.35	119.79	110.81
1	A	157	ILE	N-CA-C	-5.28	107.45	111.62

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	C	6	PRO	O-C-N	5.13	123.67	121.31
1	C	157	ILE	N-CA-C	-5.08	107.61	111.62

There are no chirality outliers.

All (7) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	1	MET	Peptide
1	B	1	MET	Peptide
1	C	1	MET	Peptide
1	C	2	ALA	Peptide
1	D	1	MET	Peptide
1	D	127	TRP	Peptide
1	D	152	ALA	Peptide

## 5.2 Too-close contacts

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	1568	0	1487	14	0
1	B	1594	0	1510	10	0
1	C	1568	0	1487	20	0
1	D	1574	0	1493	6	0
2	A	1	0	0	0	0
2	B	1	0	0	0	0
2	C	1	0	0	0	0
2	D	1	0	0	0	0
3	A	169	0	0	7	0
3	B	197	0	0	4	0
3	C	193	0	0	8	0
3	D	147	0	0	0	0
All	All	7014	0	5977	50	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 4.

All (50) 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:C:83:MET:HE2	3:C:864:HOH:O	1.48	1.12
1:B:153:ASP:HB3	3:B:812:HOH:O	1.64	0.95
1:C:197:ARG:O	1:C:197:ARG:CZ	2.20	0.89
1:C:83:MET:CE	3:C:864:HOH:O	2.14	0.80
1:C:80:TRP:HA	3:C:864:HOH:O	1.92	0.69
1:C:97:GLU:HG3	3:C:697:HOH:O	1.93	0.68
1:B:138:LYS:HD2	3:B:562:HOH:O	1.94	0.68
1:C:197:ARG:C	1:C:197:ARG:NE	2.53	0.66
1:B:39:LYS:NZ	3:B:820:HOH:O	2.26	0.63
1:A:97:GLU:HG3	3:A:534:HOH:O	1.98	0.63
1:A:18:LYS:HB2	3:A:637:HOH:O	2.02	0.60
1:C:80:TRP:CE3	3:C:864:HOH:O	2.52	0.59
1:B:5:ILE:HD11	3:B:867:HOH:O	2.06	0.56
1:C:197:ARG:O	1:C:197:ARG:NE	2.40	0.53
1:B:188:TRP:O	1:B:192:GLU:HG3	2.11	0.51
1:C:197:ARG:O	1:C:197:ARG:HG2	2.11	0.51
1:A:85:PRO:HA	3:A:637:HOH:O	2.11	0.50
1:D:112:GLU:HG2	1:D:139:VAL:HG21	1.93	0.50
1:C:197:ARG:O	1:C:197:ARG:NH1	2.44	0.50
1:A:153:ASP:OD1	1:A:153:ASP:N	2.42	0.49
1:A:196:THR:CG2	3:A:548:HOH:O	2.61	0.48
1:C:197:ARG:CZ	1:C:197:ARG:C	2.88	0.47
1:D:136:LYS:HE2	1:D:136:LYS:HB3	1.68	0.47
1:B:196:THR:O	1:B:197:ARG:HB2	2.15	0.47
1:D:58:ILE:HG23	1:D:62:GLU:HG3	1.97	0.47
1:A:34:MET:HG3	3:A:499:HOH:O	2.13	0.47
1:C:34:MET:HG3	3:C:461:HOH:O	2.14	0.47
1:D:26:THR:O	1:D:30:ASP:HB2	2.16	0.46
1:D:190:HIS:O	1:D:194:GLN:HG2	2.16	0.46
1:A:1:MET:HA	1:A:1:MET:HE2	1.98	0.46
1:A:197:ARG:HH21	1:A:197:ARG:HA	1.81	0.45
1:C:80:TRP:HE3	3:C:864:HOH:O	1.95	0.44
1:A:127:TRP:CE3	1:A:159:THR:HB	2.52	0.44
1:C:60:ARG:HD3	3:C:745:HOH:O	2.18	0.43
1:B:127:TRP:CE3	1:B:159:THR:HB	2.53	0.43
1:A:74:PHE:CD2	1:A:74:PHE:C	2.97	0.42
1:A:196:THR:HG22	3:A:548:HOH:O	2.17	0.42
1:A:190:HIS:O	1:A:194:GLN:HG2	2.20	0.42
1:C:127:TRP:CE3	1:C:159:THR:HB	2.54	0.42
1:A:185:VAL:HG12	3:A:637:HOH:O	2.19	0.42
1:B:136:LYS:HE2	1:B:136:LYS:HB3	1.19	0.41
1:C:44:ALA:HB1	1:C:51:ALA:HB2	2.02	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:26:THR:O	1:B:30:ASP:HB2	2.21	0.41
1:C:103:PHE:CD2	1:C:109:PHE:HB2	2.56	0.41
1:C:151:GLU:HG3	1:C:154:LEU:HD12	2.02	0.40
1:C:197:ARG:O	1:C:197:ARG:CG	2.66	0.40
1:B:108:LYS:HA	1:B:108:LYS:HD2	1.93	0.40
1:C:190:HIS:O	1:C:194:GLN:HG2	2.21	0.40
1:D:20:ILE:HG22	1:D:25:VAL:HG23	2.04	0.40
1:A:197:ARG:HB2	1:A:197:ARG:CZ	2.52	0.40

There are no symmetry-related clashes.

## 5.3 Torsion angles

### 5.3.1 Protein backbone

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	195/197 (99%)	192 (98%)	3 (2%)	0	100	100
1	B	198/197 (100%)	195 (98%)	3 (2%)	0	100	100
1	C	195/197 (99%)	191 (98%)	4 (2%)	0	100	100
1	D	196/197 (100%)	191 (97%)	4 (2%)	1 (0%)	24	21
All	All	784/788 (100%)	769 (98%)	14 (2%)	1 (0%)	48	46

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	D	152	ALA

### 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	160/160 (100%)	157 (98%)	3 (2%)	50	56
1	B	163/160 (102%)	161 (99%)	2 (1%)	63	70
1	C	160/160 (100%)	152 (95%)	8 (5%)	22	20
1	D	161/160 (101%)	158 (98%)	3 (2%)	50	56
All	All	644/640 (101%)	628 (98%)	16 (2%)	42	45

All (16) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	1	MET
1	A	137	LEU
1	A	196	THR
1	B	66	ILE
1	B	136	LYS
1	C	1	MET
1	C	46	SER
1	C	66	ILE
1	C	94	LYS
1	C	97	GLU
1	C	137	LEU
1	C	158	LEU
1	C	197	ARG
1	D	1	MET
1	D	46	SER
1	D	158	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (9) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	75	ASN
1	A	115	ASN
1	B	115	ASN
1	B	141	GLN
1	C	75	ASN
1	C	115	ASN
1	C	141	GLN
1	C	194	GLN
1	D	115	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 oligosaccharides 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	197/197 (100%)	-1.58	0 100 100	16, 20, 25, 34	0
1	B	197/197 (100%)	-1.54	0 100 100	8, 20, 25, 34	3 (1%)
1	C	197/197 (100%)	-1.50	0 100 100	16, 20, 25, 34	0
1	D	197/197 (100%)	-1.53	0 100 100	12, 20, 25, 34	1 (0%)
All	All	788/788 (100%)	-1.54	0 100 100	8, 20, 25, 34	4 (0%)

There are no RSRZ outliers to report.

### 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 oligosaccharides 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(Å <sup>2</sup> )	Q<0.9
2	FE	A	198	1/1	1.00	0.01	21,21,21,21	0
2	FE	B	198	1/1	1.00	0.01	23,23,23,23	0
2	FE	C	198	1/1	1.00	0.01	24,24,24,24	0
2	FE	D	198	1/1	1.00	0.02	23,23,23,23	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.