



# wwPDB X-ray Structure Validation Summary Report

Oct 19, 2023 – 05:13 AM EDT

PDB ID : 2QQ4  
Title : Crystal structure of Iron-sulfur cluster biosynthesis protein IscU (TTHA1736) from thermus thermophilus HB8  
Authors : Jeyakanthan, J.; Kanaujia, S.P.; Sekar, K.; Agari, Y.; Ebihara, A.; Shinkai, A.; Kuramitsu, S.; Yokoyama, S.; RIKEN Structural Genomics/Proteomics Initiative (RSGI)  
Deposited on : 2007-07-26  
Resolution : 1.85 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.

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  
Xtriage (Phenix) : 1.13  
EDS : 2.36  
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) : 2.36

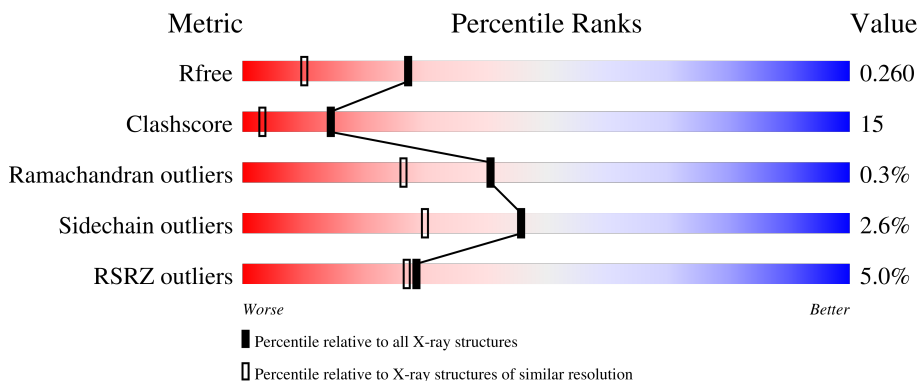
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 1.85 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.



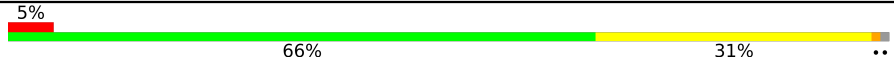

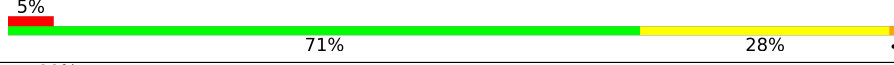


Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
$R_{free}$	130704	2469 (1.86-1.86)
Clashscore	141614	2625 (1.86-1.86)
Ramachandran outliers	138981	2592 (1.86-1.86)
Sidechain outliers	138945	2592 (1.86-1.86)
RSRZ outliers	127900	2436 (1.86-1.86)

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	138	 4% 78% 20%
1	B	138	 % 83% 17%
1	C	138	 % 78% 20%
1	D	138	 % 74% 23%
1	E	138	 4% 75% 24%

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Mol	Chain	Length	Quality of chain
1	F	138	 5% 66% 31% ..
1	G	138	 % 83% 14% ..
1	H	138	 5% 71% 28% .
1	I	138	 11% 55% 41% ..
1	J	138	 16% 69% 28% ..

## 2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 11013 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-sulfur cluster biosynthesis protein IscU.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	138	1032	649	178	197	8	0	0	0
1	B	137	1024	644	177	196	7	0	0	0
1	C	138	1032	649	178	197	8	0	0	0
1	D	137	1024	644	177	196	7	0	0	0
1	E	137	1024	644	177	196	7	0	0	0
1	F	136	1018	641	176	194	7	0	0	0
1	G	137	1024	644	177	196	7	0	0	0
1	H	138	1032	649	178	197	8	0	0	0
1	I	134	1003	630	174	192	7	0	0	0
1	J	137	1024	644	177	196	7	0	0	0

- Molecule 2 is ZINC ION (three-letter code: ZN) (formula: Zn).

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

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Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	E	1	Total 1	Zn 1	0	0
2	F	1	Total 1	Zn 1	0	0
2	G	1	Total 1	Zn 1	0	0
2	H	1	Total 1	Zn 1	0	0
2	I	1	Total 1	Zn 1	0	0
2	J	1	Total 1	Zn 1	0	0

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	108	Total 108	O 108	0	0
3	B	84	Total 84	O 84	0	0
3	C	97	Total 97	O 97	0	0
3	D	99	Total 99	O 99	0	0
3	E	77	Total 77	O 77	0	0
3	F	49	Total 49	O 49	0	0
3	G	87	Total 87	O 87	0	0
3	H	57	Total 57	O 57	0	0
3	I	48	Total 48	O 48	0	0
3	J	60	Total 60	O 60	0	0



A136  
L137  
R138

- Molecule 1: Iron-sulfur cluster biosynthesis protein IscU

Chain F: 5% 66% 31% ..

MET SER V3 L4 D5 E6 L7 Y6 R9 E10 I11 L12 L13 V24 L25 L26 P26 Q27 K30 N35 N36 P37 S38 C39 G40 D41 Q42 V43 E44 V45 M46 D52 D56 E57 R58 G61 Q62 G63 L73 M74 K79 K82 V83 A84 E85 V97 G108 L110

P120 A121 V123 L128 A129 W130 A136 L137 R138

- Molecule 1: Iron-sulfur cluster biosynthesis protein IscU

Chain G: 83% 14% ..

MET S2 D6 Y8 R9 K30 Q31 M35 Q42 V43 E44 V45 M46 V47 L48 L49 T53 R58 I54 A55 Q60 A65 E68 R91 P103 K118 L119 K124 T127 R138

- Molecule 1: Iron-sulfur cluster biosynthesis protein IscU

Chain H: 5% 71% 28% .

M1 S2 V3 D5 E6 W21 V24 K30 Q31 M35 V43 E44 M46 D52 I57 R58 F59 Q62 I66 M74 K79 K82 V83 A84 E85 E88 R91 K92 K95 A95 R96 V97 P102 P103 P104 T106 L111 V116 A117 A121 R122

W130 E134 E135 A136 L137 R138

- Molecule 1: Iron-sulfur cluster biosynthesis protein IscU

Chain I: 11% 55% 41% ..

MET SER VAL LEU D5 E6 L7 Y8 R9 I10 I11 Y16 G23 V24 L25 P26 Q27 Q31 A32 G33 G34 M35 N36 P37 S38 C39 G40 D41 Q42 V43 E44 V45 M46 V47 E50 E51 D52 T53 I54 A55 Q60 G61 Q62 I66 K71 T75 K82 E85 E88

L89 S90 R91 K92 R93 Q94 A95 R96 V97 V98 E99 G100 A101 P102 P103 T106 L107 G108 G109 L110 L111 A112 L113 Q114 N117 A118 L119 P120 A121 R122 V123 K124 L128 E134 R138

- Molecule 1: Iron-sulfur cluster biosynthesis protein IscU

Chain J: 16% 69% 28% ..

MET S2 V3 L4 D5 R9 L13 Y16 M21 F22 G23 V24 L25 P26 Q27 A28 A29 K30 Q31 A32 N35 N36 D41 E44 V45 M46 V47 L48 L49 E50 E51 D52 A55 D56 I57 R58 F59 G60 E76 K79 K82 V83 A84 E85 E88 V97 V98





## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	58.89Å 64.87Å 96.26Å 71.18° 78.96° 79.02°	Depositor
Resolution (Å)	38.85 – 1.85 39.06 – 1.85	Depositor EDS
% Data completeness (in resolution range)	92.6 (38.85-1.85) 92.7 (39.06-1.85)	Depositor EDS
$R_{merge}$	0.04	Depositor
$R_{sym}$	0.04	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.83 (at 1.85Å)	Xtrriage
Refinement program	CNS 1.1	Depositor
R, $R_{free}$	0.225 , 0.260 0.225 , 0.260	Depositor DCC
$R_{free}$ test set	10594 reflections (10.03%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	27.5	Xtrriage
Anisotropy	0.153	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.35 , 55.1	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.50$ , $\langle L^2 \rangle = 0.33$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	11013	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	40.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.60% 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:  
ZN

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	0.37	0/1047	0.60	0/1417
1	B	0.35	0/1039	0.56	0/1407
1	C	0.35	0/1047	0.61	0/1417
1	D	0.32	0/1039	0.56	0/1407
1	E	0.32	0/1039	0.57	0/1407
1	F	0.27	0/1033	0.55	0/1399
1	G	0.29	0/1039	0.53	0/1407
1	H	0.28	0/1047	0.51	0/1417
1	I	0.34	0/1018	0.61	0/1378
1	J	0.28	0/1039	0.50	0/1407
All	All	0.32	0/10387	0.56	0/14063

There are no bond length outliers.

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	1032	0	1051	34	0
1	B	1024	0	1039	19	0
1	C	1032	0	1051	31	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	D	1024	0	1039	33	0
1	E	1024	0	1039	29	0
1	F	1018	0	1034	40	0
1	G	1024	0	1039	16	0
1	H	1032	0	1051	43	0
1	I	1003	0	1014	61	0
1	J	1024	0	1039	52	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
2	E	1	0	0	0	0
2	F	1	0	0	0	0
2	G	1	0	0	0	0
2	H	1	0	0	0	0
2	I	1	0	0	0	0
2	J	1	0	0	0	0
3	A	108	0	0	3	0
3	B	84	0	0	2	0
3	C	97	0	0	5	0
3	D	99	0	0	3	0
3	E	77	0	0	2	0
3	F	49	0	0	1	0
3	G	87	0	0	2	0
3	H	57	0	0	0	0
3	I	48	0	0	3	0
3	J	60	0	0	3	0
All	All	11013	0	10396	317	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 15.

The worst 5 of 317 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:G:35:MET:HG2	1:G:42:GLN:HG2	1.46	0.95
1:C:1:MET:HB3	3:C:258:HOH:O	1.72	0.90
1:A:104:ASP:OD1	1:A:106:THR:HG22	1.70	0.90
1:B:3:VAL:HG11	1:E:12:LEU:HD12	1.54	0.88
1:I:36:ASN:HD21	1:I:124:LYS:HB3	1.40	0.86

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	136/138 (99%)	133 (98%)	3 (2%)	0	100	100
1	B	135/138 (98%)	133 (98%)	2 (2%)	0	100	100
1	C	136/138 (99%)	132 (97%)	4 (3%)	0	100	100
1	D	135/138 (98%)	131 (97%)	4 (3%)	0	100	100
1	E	135/138 (98%)	130 (96%)	4 (3%)	1 (1%)	22	9
1	F	134/138 (97%)	126 (94%)	7 (5%)	1 (1%)	22	9
1	G	135/138 (98%)	132 (98%)	2 (2%)	1 (1%)	22	9
1	H	136/138 (99%)	135 (99%)	1 (1%)	0	100	100
1	I	132/138 (96%)	122 (92%)	9 (7%)	1 (1%)	19	7
1	J	135/138 (98%)	129 (96%)	6 (4%)	0	100	100
All	All	1349/1380 (98%)	1303 (97%)	42 (3%)	4 (0%)	41	26

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	I	112	ALA
1	E	3	VAL
1	G	103	PRO
1	F	37	PRO

### 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	109/109 (100%)	104 (95%)	5 (5%)	27	11
1	B	108/109 (99%)	108 (100%)	0	100	100
1	C	109/109 (100%)	107 (98%)	2 (2%)	59	45
1	D	108/109 (99%)	104 (96%)	4 (4%)	34	17
1	E	108/109 (99%)	106 (98%)	2 (2%)	57	43
1	F	107/109 (98%)	105 (98%)	2 (2%)	57	43
1	G	108/109 (99%)	106 (98%)	2 (2%)	57	43
1	H	109/109 (100%)	106 (97%)	3 (3%)	43	27
1	I	105/109 (96%)	101 (96%)	4 (4%)	33	16
1	J	108/109 (99%)	104 (96%)	4 (4%)	34	17
All	All	1079/1090 (99%)	1051 (97%)	28 (3%)	46	30

5 of 28 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	F	122	ARG
1	J	36	ASN
1	H	35	MET
1	J	16	TYR
1	G	124	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 28 such sidechains are listed below:

Mol	Chain	Res	Type
1	F	36	ASN
1	J	94	GLN
1	G	60	GLN
1	I	131	HIS
1	G	31	GLN

### 5.3.3 RNA ⓘ

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](#)

Of 10 ligands modelled in this entry, 10 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	138/138 (100%)	0.03	6 (4%) 35 33	15, 27, 66, 97	0
1	B	137/138 (99%)	-0.08	2 (1%) 73 74	17, 30, 56, 67	0
1	C	138/138 (100%)	-0.08	2 (1%) 75 76	16, 29, 50, 74	0
1	D	137/138 (99%)	-0.14	2 (1%) 73 74	18, 33, 55, 76	0
1	E	137/138 (99%)	0.16	5 (3%) 42 40	20, 34, 59, 76	0
1	F	136/138 (98%)	0.48	7 (5%) 28 26	25, 43, 76, 88	0
1	G	137/138 (99%)	0.16	1 (0%) 87 88	20, 37, 61, 84	0
1	H	138/138 (100%)	0.32	7 (5%) 28 26	24, 44, 70, 85	0
1	I	134/138 (97%)	0.62	15 (11%) 5 5	20, 47, 78, 93	0
1	J	137/138 (99%)	0.94	22 (16%) 1 2	29, 49, 85, 98	0
All	All	1369/1380 (99%)	0.24	69 (5%) 28 27	15, 37, 70, 98	0

The worst 5 of 69 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	F	39	CYS	5.9
1	J	26	PRO	5.7
1	F	121	ALA	5.7
1	I	119	LEU	5.3
1	I	37	PRO	5.3

### 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](#)

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	ZN	I	139	1/1	0.71	0.27	92,92,92,92	0
2	ZN	F	139	1/1	0.93	0.04	59,59,59,59	0
2	ZN	B	139	1/1	0.97	0.04	29,29,29,29	0
2	ZN	E	139	1/1	0.98	0.04	28,28,28,28	0
2	ZN	J	139	1/1	0.98	0.03	36,36,36,36	0
2	ZN	H	139	1/1	0.99	0.04	35,35,35,35	0
2	ZN	G	139	1/1	1.00	0.05	28,28,28,28	0
2	ZN	D	139	1/1	1.00	0.03	24,24,24,24	0
2	ZN	A	139	1/1	1.00	0.02	24,24,24,24	0
2	ZN	C	139	1/1	1.00	0.05	26,26,26,26	0

### 6.5 Other polymers [i](#)

There are no such residues in this entry.