



# Full wwPDB X-ray Structure Validation Report ⓘ

Aug 20, 2023 – 01:51 AM EDT

PDB ID : 2H3H  
Title : Crystal structure of the liganded form of Thermotoga maritima glucose binding protein  
Authors : Changela, A.; Tian, Y.  
Deposited on : 2006-05-22  
Resolution : 1.70 Å(reported)

This is a Full wwPDB X-ray Structure Validation 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  
Mogul : 1.8.5 (274361), CSD as541be (2020)  
Xtriage (Phenix) : 1.13  
EDS : 2.35  
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) : 2.35

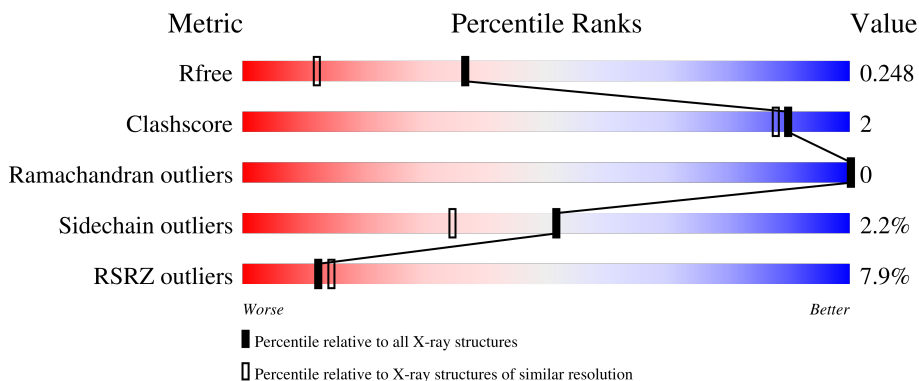
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 1.70 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	4298 (1.70-1.70)
Clashscore	141614	4695 (1.70-1.70)
Ramachandran outliers	138981	4610 (1.70-1.70)
Sidechain outliers	138945	4610 (1.70-1.70)
RSRZ outliers	127900	4222 (1.70-1.70)

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	313	97%
1	B	313	15% 90% 7%

## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 5417 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 Sugar ABC transporter, periplasmic sugar-binding protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	313	2417	1545	395	463	14	0	5	0
1	B	305	2308	1481	370	444	13	0	0	0

There are 18 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1	MET	-	initiating methionine	UNP Q9WXW9
A	306	GLY	-	cloning artifact	UNP Q9WXW9
A	307	SER	-	cloning artifact	UNP Q9WXW9
A	308	HIS	-	cloning artifact	UNP Q9WXW9
A	309	HIS	-	cloning artifact	UNP Q9WXW9
A	310	HIS	-	cloning artifact	UNP Q9WXW9
A	311	HIS	-	cloning artifact	UNP Q9WXW9
A	312	HIS	-	cloning artifact	UNP Q9WXW9
A	313	HIS	-	cloning artifact	UNP Q9WXW9
B	1	MET	-	initiating methionine	UNP Q9WXW9
B	306	GLY	-	cloning artifact	UNP Q9WXW9
B	307	SER	-	cloning artifact	UNP Q9WXW9
B	308	HIS	-	cloning artifact	UNP Q9WXW9
B	309	HIS	-	cloning artifact	UNP Q9WXW9
B	310	HIS	-	cloning artifact	UNP Q9WXW9
B	311	HIS	-	cloning artifact	UNP Q9WXW9
B	312	HIS	-	cloning artifact	UNP Q9WXW9
B	313	HIS	-	cloning artifact	UNP Q9WXW9

- Molecule 2 is beta-D-glucopyranose (three-letter code: BGC) (formula: C<sub>6</sub>H<sub>12</sub>O<sub>6</sub>).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	1	Total C O 12 6 6	0	0
2	B	1	Total C O 12 6 6	0	0

- Molecule 3 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	460	Total O 460 460	0	0
3	B	208	Total O 208 208	0	0

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

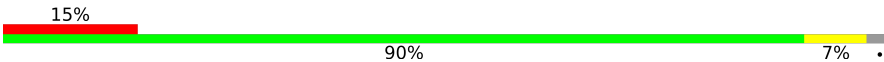
These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry and electron density. 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.

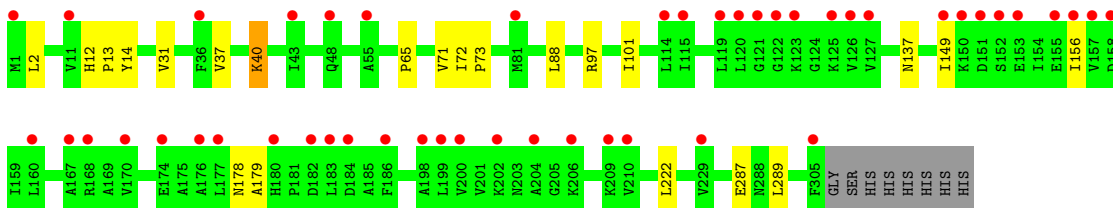
- Molecule 1: Sugar ABC transporter, periplasmic sugar-binding protein

Chain A:  97%



- Molecule 1: Sugar ABC transporter, periplasmic sugar-binding protein

Chain B:  15% 90% 7%



## 4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	148.20Å 46.06Å 118.40Å 90.00° 108.22° 90.00°	Depositor
Resolution (Å)	50.00 – 1.70 38.45 – 1.70	Depositor EDS
% Data completeness (in resolution range)	95.1 (50.00-1.70) 95.1 (38.45-1.70)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	0.06	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.93 (at 1.70Å)	Xtrriage
Refinement program	REFMAC 5.2.0005	Depositor
R, $R_{free}$	0.203 , 0.241 0.210 , 0.248	Depositor DCC
$R_{free}$ test set	4030 reflections (5.04%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	18.8	Xtrriage
Anisotropy	0.192	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.34 , 57.1	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.47$ , $\langle L^2 \rangle = 0.30$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.95	EDS
Total number of atoms	5417	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	30.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.05% 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: BGC

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	0.51	0/2461	0.63	0/3337
1	B	0.40	0/2346	0.53	0/3180
All	All	0.46	0/4807	0.58	0/6517

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	2417	0	2446	7	0
1	B	2308	0	2365	10	0
2	A	12	0	12	0	0
2	B	12	0	12	0	0
3	A	460	0	0	5	0
3	B	208	0	0	1	0
All	All	5417	0	4835	17	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 2.

All (17) 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:A:218[A]:THR:HG23	3:A:1935:HOH:O	1.93	0.68
1:A:17:GLN:NE2	3:A:1935:HOH:O	2.27	0.67
1:B:149:ILE:HD11	1:B:156:ILE:HD11	1.83	0.60
1:A:218[A]:THR:CG2	3:A:1935:HOH:O	2.54	0.55
1:B:2:LEU:HB2	1:B:31:VAL:HG23	1.91	0.53
1:B:12:HIS:CD2	1:B:14:TYR:H	2.31	0.49
1:B:12:HIS:HD2	1:B:14:TYR:H	1.58	0.49
1:B:178:ASN:OD1	1:B:179:ALA:N	2.46	0.49
1:A:12:HIS:CE1	1:A:191:ALA:HB1	2.53	0.44
1:B:72:ILE:HB	1:B:73:PRO:HD3	2.00	0.42
1:A:119:LEU:HD13	3:A:1644:HOH:O	2.20	0.42
1:B:12:HIS:CG	1:B:13:PRO:HD2	2.55	0.41
1:B:65:PRO:HB3	1:B:71:VAL:HG11	2.03	0.41
1:A:299:LEU:HD22	3:A:1709:HOH:O	2.21	0.41
1:A:218[B]:THR:HG22	1:A:219:PRO:HD2	2.02	0.41
1:B:88:LEU:HA	1:B:101:ILE:O	2.20	0.41
1:B:40:LYS:NZ	3:B:1590:HOH:O	2.53	0.41

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	316/313 (101%)	308 (98%)	8 (2%)	0	100	100
1	B	303/313 (97%)	295 (97%)	8 (3%)	0	100	100
All	All	619/626 (99%)	603 (97%)	16 (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	262/257 (102%)	258 (98%)	4 (2%)	65	51
1	B	250/257 (97%)	243 (97%)	7 (3%)	43	25
All	All	512/514 (100%)	501 (98%)	11 (2%)	52	36

All (11) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	47	LEU
1	A	97	ARG
1	A	119	LEU
1	A	222	LEU
1	B	37	VAL
1	B	40	LYS
1	B	97	ARG
1	B	137	ASN
1	B	222	LEU
1	B	287	GLU
1	B	289	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (7) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	20	GLN
1	A	258	GLN
1	A	311	HIS
1	A	313	HIS
1	B	48	GLN
1	B	137	ASN
1	B	236	GLN

### 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 monosaccharides in this entry.

## 5.6 Ligand geometry [i](#)

2 ligands are modelled in this entry.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. 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  $|Z| > 2$  is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z  > 2	Counts	RMSZ	# Z  > 2
2	BGC	B	1501	-	12,12,12	0.60	0	17,17,17	0.89	0
2	BGC	A	1500	-	12,12,12	0.61	0	17,17,17	1.20	2 (11%)

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	BGC	B	1501	-	-	0/2/22/22	0/1/1/1
2	BGC	A	1500	-	-	0/2/22/22	0/1/1/1

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	1500	BGC	C3-C4-C5	-2.80	105.24	110.24
2	A	1500	BGC	O4-C4-C5	2.24	114.86	109.30

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

There are no such residues in this entry.

## 5.8 Polymer linkage issues

There are no chain breaks in this entry.

## 6 Fit of model and data

### 6.1 Protein, DNA and RNA chains

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	313/313 (100%)	-0.27	1 (0%) <span style="border: 1px solid blue; padding: 2px;">94</span> <span style="border: 1px solid blue; padding: 2px;">94</span>	10, 18, 34, 38	0
1	B	305/313 (97%)	0.74	48 (15%) <span style="border: 1px solid red; padding: 2px;">2</span> <span style="border: 1px solid red; padding: 2px;">2</span>	16, 40, 60, 63	0
All	All	618/626 (98%)	0.23	49 (7%) <span style="border: 1px solid red; padding: 2px;">12</span> <span style="border: 1px solid red; padding: 2px;">14</span>	10, 26, 58, 63	0

All (49) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	210	VAL	5.6
1	B	183	LEU	5.1
1	B	127	VAL	4.9
1	B	170	VAL	4.9
1	B	55	ALA	4.1
1	B	209	LYS	4.0
1	B	119	LEU	3.9
1	B	186	PHE	3.6
1	B	174	GLU	3.5
1	B	206	LYS	3.5
1	B	199	LEU	3.4
1	B	182	ASP	3.4
1	B	121	GLY	3.3
1	B	126	VAL	3.2
1	B	180	HIS	3.1
1	B	150	LYS	3.0
1	B	151	ASP	2.9
1	B	202	LYS	2.9
1	B	157	VAL	2.9
1	B	81	MET	2.9
1	B	125	LYS	2.8
1	B	152	SER	2.8
1	B	123	LYS	2.8
1	B	122	GLY	2.8

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Mol	Chain	Res	Type	RSRZ
1	B	156	ILE	2.7
1	B	229	VAL	2.6
1	B	184	ASP	2.5
1	A	151	ASP	2.5
1	B	43	ILE	2.5
1	B	153	GLU	2.4
1	B	177	LEU	2.4
1	B	168	ARG	2.3
1	B	1	MET	2.3
1	B	149	ILE	2.3
1	B	158	ASP	2.3
1	B	11	VAL	2.3
1	B	204	ALA	2.3
1	B	114	LEU	2.2
1	B	120	LEU	2.2
1	B	155	GLU	2.2
1	B	176	ALA	2.2
1	B	305	PHE	2.1
1	B	160	LEU	2.1
1	B	115	ILE	2.1
1	B	48	GLN	2.1
1	B	167	ALA	2.1
1	B	198	ALA	2.1
1	B	36	PHE	2.1
1	B	200	VAL	2.0

## 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( $\text{\AA}^2$ )	Q<0.9
2	BGC	B	1501	12/12	0.88	0.10	28,29,32,34	0
2	BGC	A	1500	12/12	0.98	0.09	10,11,12,14	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.