



Full wwPDB X-ray Structure Validation Report ⓘ

Dec 16, 2023 – 05:27 PM EST

PDB ID : 2NSA
Title : Structures of and interactions between domains of trigger factor from *Thermotoga maritima*
Authors : Martinez-Hackert, E.; Hendrickson, W.A.
Deposited on : 2006-11-03
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

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>.

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 : 2.36
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

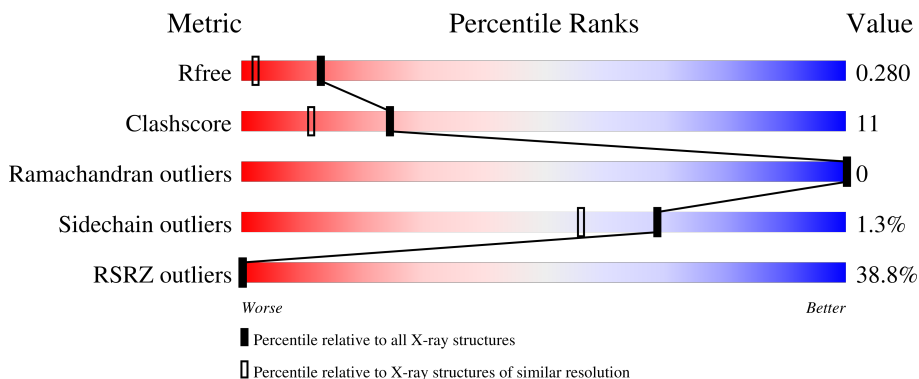
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 1.70 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 ≥ 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	170	

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 1629 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 Trigger factor.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	Se			
1	A	167	1406	882	244	278	2	0	0	0

There are 10 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	243	GLY	-	cloning artifact	UNP Q9WZF8
A	267	MSE	MET	modified residue	UNP Q9WZF8
A	271	MSE	MET	modified residue	UNP Q9WZF8
A	406	GLU	-	cloning artifact	UNP Q9WZF8
A	407	HIS	-	expression tag	UNP Q9WZF8
A	408	HIS	-	expression tag	UNP Q9WZF8
A	409	HIS	-	expression tag	UNP Q9WZF8
A	410	HIS	-	expression tag	UNP Q9WZF8
A	411	HIS	-	expression tag	UNP Q9WZF8
A	412	HIS	-	expression tag	UNP Q9WZF8

- Molecule 2 is SULFATE ION (three-letter code: SO4) (formula: O₄S).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	O	S	0	0
			5	4	1		
2	A	1	Total	O	S	0	0
			5	4	1		
2	A	1	Total	O	S	0	0
			5	4	1		

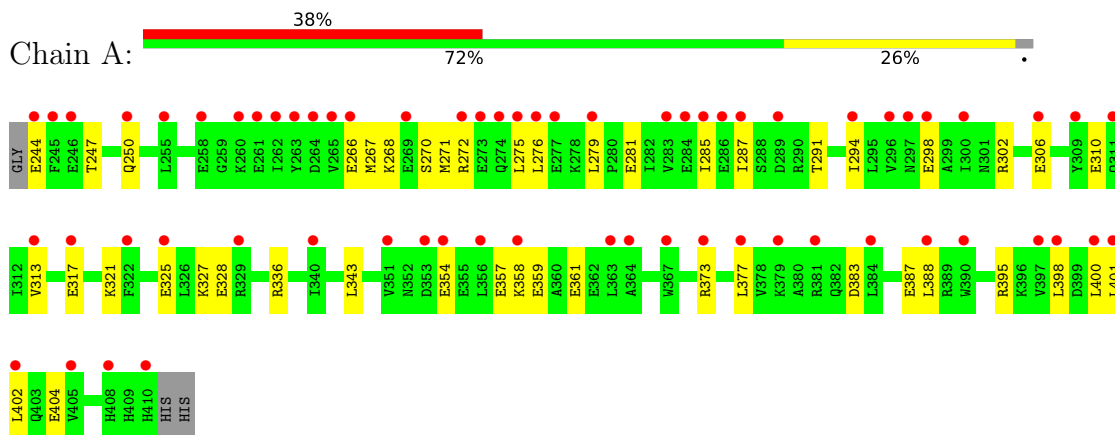
- Molecule 3 is water.

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

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: Trigger factor



4 Data and refinement statistics

Property	Value	Source
Space group	C 2 2 21	Depositor
Cell constants a, b, c, α , β , γ	53.84Å 74.21Å 90.07Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	20.00 – 1.70 19.25 – 2.19	Depositor EDS
% Data completeness (in resolution range)	97.1 (20.00-1.70) 90.5 (19.25-2.19)	Depositor EDS
R_{merge}	0.04	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	5.01 (at 2.19Å)	Xtrriage
Refinement program	CNS	Depositor
R, R_{free}	0.227 , 0.252 0.270 , 0.280	Depositor DCC
R_{free} test set	413 reflections (4.75%)	wwPDB-VP
Wilson B-factor (Å ²)	35.0	Xtrriage
Anisotropy	0.137	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.39 , 51.1	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.32$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.90	EDS
Total number of atoms	1629	wwPDB-VP
Average B, all atoms (Å ²)	31.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 7.89% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical 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: SO4

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	0.27	0/1420	0.47	0/1897

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	1406	0	1423	31	0
2	A	15	0	0	0	0
3	A	208	0	0	9	0
All	All	1629	0	1423	31	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 11.

All (31) 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:325:GLU:HG3	3:A:525:HOH:O	1.84	0.76

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:271:MSE:HB3	1:A:402:LEU:HD22	1.71	0.73
1:A:287:ILE:HD11	1:A:291:THR:HG21	1.74	0.70
1:A:317:GLU:HB3	3:A:590:HOH:O	1.93	0.66
1:A:400:LEU:O	1:A:404:GLU:HG3	1.98	0.64
1:A:267:MSE:HA	3:A:563:HOH:O	1.96	0.64
1:A:271:MSE:HG2	3:A:563:HOH:O	1.99	0.62
1:A:357:GLU:O	1:A:361:GLU:HG3	2.00	0.61
1:A:302:ARG:O	1:A:306:GLU:HG3	2.02	0.60
1:A:285:ILE:HD13	3:A:564:HOH:O	2.02	0.58
1:A:359:GLU:HG2	1:A:388:LEU:HD11	1.87	0.57
1:A:244:GLU:HB2	1:A:281:GLU:OE1	2.06	0.56
1:A:276:LEU:HD22	1:A:336:ARG:HD3	1.89	0.54
1:A:395:ARG:HD2	3:A:568:HOH:O	2.08	0.53
1:A:359:GLU:CG	1:A:388:LEU:HD11	2.39	0.53
1:A:276:LEU:HD21	1:A:398:LEU:HD11	1.92	0.52
1:A:354:GLU:OE2	1:A:358:LYS:HE3	2.10	0.52
1:A:247:THR:OG1	1:A:250:GLN:HG3	2.12	0.50
1:A:383:ASP:O	1:A:387:GLU:HG3	2.12	0.49
1:A:271:MSE:HB3	1:A:402:LEU:CD2	2.41	0.49
1:A:373:ARG:O	1:A:377:LEU:HD13	2.15	0.47
1:A:321:LYS:HA	1:A:321:LYS:HE2	1.97	0.46
1:A:268:LYS:HB3	1:A:272:ARG:CZ	2.47	0.44
1:A:268:LYS:HB3	1:A:272:ARG:NH2	2.32	0.44
1:A:270:SER:HB3	3:A:563:HOH:O	2.17	0.44
1:A:294:ILE:O	1:A:298:GLU:HG3	2.17	0.44
1:A:343:LEU:HD13	1:A:401:LEU:HD11	2.00	0.43
1:A:327:LYS:NZ	3:A:532:HOH:O	2.52	0.42
1:A:272:ARG:NH2	3:A:568:HOH:O	2.52	0.42
1:A:310:GLU:HA	1:A:313:VAL:HG12	2.03	0.41
1:A:275:LEU:O	1:A:279:LEU:HG	2.21	0.40

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	165/170 (97%)	164 (99%)	1 (1%)	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	156/156 (100%)	154 (99%)	2 (1%)	69	56

All (2) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	266	GLU
1	A	328	GLU

Sometimes 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 monosaccharides in this entry.

5.6 Ligand geometry [i](#)

3 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	SO4	A	415	-	4,4,4	0.27	0	6,6,6	0.05	0
2	SO4	A	414	-	4,4,4	0.28	0	6,6,6	0.04	0
2	SO4	A	413	-	4,4,4	0.25	0	6,6,6	0.06	0

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

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, 95th 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 ²)	Q<0.9
1	A	165/170 (97%)	1.85	64 (38%) 0 0	12, 26, 49, 61	0

All (64) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	408	HIS	6.3
1	A	245	PHE	6.1
1	A	266	GLU	5.0
1	A	286	GLU	4.8
1	A	410	HIS	4.8
1	A	401	LEU	4.5
1	A	263	TYR	4.5
1	A	260	LYS	4.3
1	A	402	LEU	4.2
1	A	317	GLU	4.0
1	A	377	LEU	3.9
1	A	258	GLU	3.8
1	A	275	LEU	3.6
1	A	294	ILE	3.6
1	A	358	LYS	3.5
1	A	367	TRP	3.5
1	A	398	LEU	3.3
1	A	388	LEU	3.2
1	A	273	GLU	3.2
1	A	300	ILE	3.2
1	A	261	GLU	3.2
1	A	364	ALA	3.1
1	A	296	VAL	3.1
1	A	276	LEU	3.1
1	A	269	GLU	3.0
1	A	340	ILE	3.0
1	A	279	LEU	2.9

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Mol	Chain	Res	Type	RSRZ
1	A	381	ARG	2.9
1	A	246	GLU	2.8
1	A	272	ARG	2.8
1	A	264	ASP	2.8
1	A	289	ASP	2.8
1	A	255	LEU	2.8
1	A	397	VAL	2.8
1	A	262	ILE	2.7
1	A	265	VAL	2.7
1	A	297	ASN	2.7
1	A	356	LEU	2.7
1	A	311	GLN	2.7
1	A	363	LEU	2.7
1	A	322	PHE	2.6
1	A	353	ASP	2.6
1	A	400	LEU	2.6
1	A	329	ARG	2.5
1	A	284	GLU	2.5
1	A	351	VAL	2.4
1	A	379	LYS	2.4
1	A	313	VAL	2.4
1	A	250	GLN	2.4
1	A	354	GLU	2.4
1	A	306	GLU	2.4
1	A	384	LEU	2.3
1	A	274	GLN	2.3
1	A	298	GLU	2.2
1	A	373	ARG	2.2
1	A	309	TYR	2.1
1	A	405	VAL	2.1
1	A	277	GLU	2.1
1	A	325	GLU	2.1
1	A	244	GLU	2.1
1	A	287	ILE	2.1
1	A	285	ILE	2.0
1	A	283	VAL	2.0
1	A	390	TRP	2.0

6.2 Non-standard residues in protein, DNA, RNA chains

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, 95th 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(\AA^2)	Q<0.9
2	SO4	A	415	5/5	0.69	0.30	65,65,66,67	0
2	SO4	A	414	5/5	0.74	0.24	64,65,65,66	0
2	SO4	A	413	5/5	0.91	0.23	54,54,56,56	0

6.5 Other polymers [i](#)

There are no such residues in this entry.