



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 5, 2026 – 05:56 PM UTC

PDB ID : 4EPC / pdb_00004epc
Title : Crystal structure of Autolysin repeat domains from Staphylococcus epidermidis
Authors : Zoll, S.; Stehle, T.
Deposited on : 2012-04-17
Resolution : 2.90 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 : 4-5-2 with Phenix2.0
Mogul : 2022.3.0, CSD as543be (2022)
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

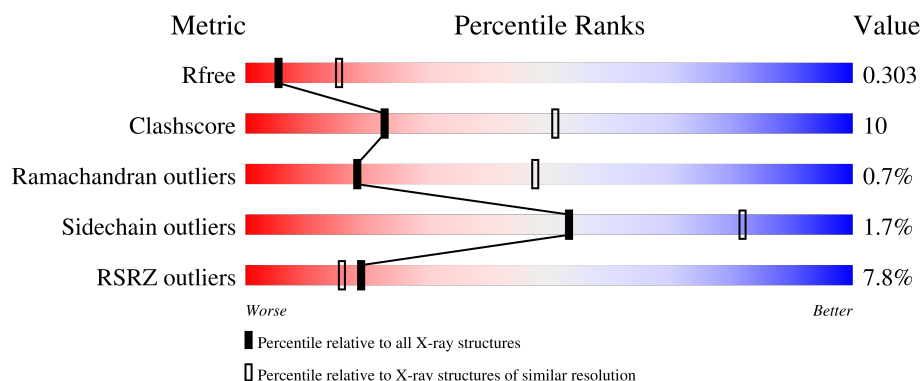
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.90 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	2481 (2.90-2.90)
Clashscore	190562	2690 (2.90-2.90)
Ramachandran outliers	187476	2623 (2.90-2.90)
Sidechain outliers	187428	2625 (2.90-2.90)
RSRZ outliers	180081	2481 (2.90-2.90)

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	334	

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 1223 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 N-acetylmuramoyl-L-alanine amidase.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
1	A	152	Total	C	N	O	0	0	0
			1205	770	202	233			

There are 2 discrepancies between the modelled and reference sequences:

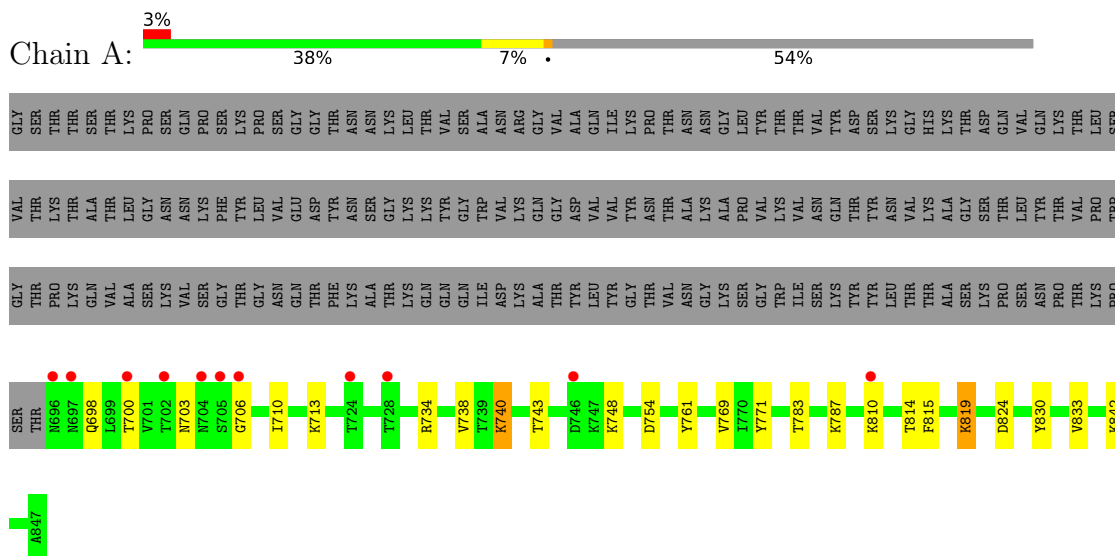
Chain	Residue	Modelled	Actual	Comment	Reference
A	514	GLY	-	expression tag	UNP O33635
A	515	SER	-	expression tag	UNP O33635

- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	18	Total	O	0	0
			18	18		

i

- Molecule 1: N-acetylmuramoyl-L-alanine amidase



4 Data and refinement statistics

Property	Value	Source
Space group	P 61 2 2	Depositor
Cell constants a, b, c, α , β , γ	95.36Å 95.36Å 233.67Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	25.65 – 2.90 25.65 – 2.90	Depositor EDS
% Data completeness (in resolution range)	99.1 (25.65-2.90) 98.9 (25.65-2.90)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.22 (at 2.90Å)	Xtriage
Refinement program	BUSTER 2.10.0	Depositor
R, R_{free}	0.263 , 0.298 0.309 , 0.303	Depositor DCC
R_{free} test set	726 reflections (5.00%)	wwPDB-VP
Wilson B-factor (Å ²)	56.3	Xtriage
Anisotropy	0.806	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.32 , 51.1	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.85	EDS
Total number of atoms	1223	wwPDB-VP
Average B, all atoms (Å ²)	55.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.25% 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: MLY

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	0.86	0/1107	1.11	0/1517

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	1205	0	1206	25	0
2	A	18	0	0	3	0
All	All	1223	0	1206	25	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.

All (25) 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:706:GLY:HA3	1:A:771:TYR:CE1	1.92	1.03
1:A:706:GLY:O	1:A:738:VAL:HB	1.63	0.99

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:706:GLY:O	1:A:738:VAL:CG2	2.20	0.89
1:A:706:GLY:O	1:A:738:VAL:CB	2.25	0.85
1:A:734:ARG:HD2	2:A:901:HOH:O	1.78	0.83
1:A:706:GLY:HA3	1:A:771:TYR:CZ	2.16	0.81
1:A:815:PHE:HD1	1:A:833:VAL:HG23	1.51	0.74
1:A:710:ILE:HA	1:A:769:VAL:HG12	1.75	0.69
1:A:787:MLY:HE2	2:A:910:HOH:O	1.97	0.63
1:A:700:THR:OG1	1:A:743:THR:HB	2.02	0.59
1:A:703:ASN:OD1	1:A:740:MLY:HE3	2.02	0.58
1:A:706:GLY:O	1:A:738:VAL:HG23	2.05	0.55
1:A:734:ARG:NH2	2:A:907:HOH:O	2.35	0.55
1:A:754:ASP:HB2	1:A:761:TYR:HE2	1.74	0.52
1:A:819:MLY:HD3	1:A:830:TYR:CD2	2.48	0.48
1:A:754:ASP:HB2	1:A:761:TYR:CE2	2.48	0.47
1:A:700:THR:HG1	1:A:743:THR:HB	1.78	0.47
1:A:706:GLY:O	1:A:738:VAL:HG21	2.11	0.46
1:A:815:PHE:CD1	1:A:833:VAL:HG23	2.40	0.46
1:A:783:THR:CG2	1:A:814:THR:HG23	2.46	0.46
1:A:819:MLY:HH22	1:A:830:TYR:CD2	2.52	0.45
1:A:706:GLY:CA	1:A:771:TYR:CE1	2.82	0.44
1:A:819:MLY:HH22	1:A:830:TYR:CE2	2.52	0.44
1:A:706:GLY:C	1:A:738:VAL:HB	2.39	0.43
1:A:819:MLY:HD3	1:A:819:MLY:HH22	1.87	0.42

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	139/334 (42%)	134 (96%)	4 (3%)	1 (1%)	18 48

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	824	ASP

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	117/272 (43%)	115 (98%)	2 (2%)	53 82

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

Mol	Chain	Res	Type
1	A	698	GLN
1	A	810	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (3) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	704	ASN
1	A	709	GLN
1	A	733	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](#)

11 non-standard protein/DNA/RNA residues 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	$\# Z > 2$
1	MLY	A	765	1	9,10,11	0.81	0	6,11,13	0.66	0
1	MLY	A	787	1	9,10,11	0.92	0	6,11,13	0.89	0
1	MLY	A	747	1	9,10,11	0.89	0	6,11,13	0.53	0
1	MLY	A	819	1	9,10,11	1.40	1 (11%)	6,11,13	0.74	0
1	MLY	A	748	1	9,10,11	1.39	2 (22%)	6,11,13	0.90	0
1	MLY	A	740	1	9,10,11	1.18	2 (22%)	6,11,13	1.14	0
1	MLY	A	713	1	9,10,11	1.30	1 (11%)	6,11,13	1.28	1 (16%)
1	MLY	A	791	1	9,10,11	0.81	0	6,11,13	0.99	0
1	MLY	A	842	1	9,10,11	1.33	1 (11%)	6,11,13	0.82	0
1	MLY	A	825	1	9,10,11	1.20	0	6,11,13	0.69	0
1	MLY	A	775	1	9,10,11	1.30	0	6,11,13	0.88	0

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
1	MLY	A	765	1	-	2/8/9/11	-
1	MLY	A	787	1	-	1/8/9/11	-
1	MLY	A	747	1	-	3/8/9/11	-
1	MLY	A	819	1	-	6/8/9/11	-
1	MLY	A	748	1	-	4/8/9/11	-
1	MLY	A	740	1	-	6/8/9/11	-
1	MLY	A	713	1	-	5/8/9/11	-
1	MLY	A	791	1	-	3/8/9/11	-
1	MLY	A	842	1	-	4/8/9/11	-
1	MLY	A	825	1	-	5/8/9/11	-
1	MLY	A	775	1	-	4/8/9/11	-

All (7) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	819	MLY	CB-CA	2.73	1.57	1.53
1	A	842	MLY	CB-CA	-2.44	1.49	1.53
1	A	748	MLY	CH2-NZ	2.37	1.53	1.46

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	713	MLY	CE-NZ	2.23	1.54	1.46
1	A	740	MLY	CB-CA	2.19	1.56	1.53
1	A	748	MLY	CH1-NZ	2.19	1.52	1.46
1	A	740	MLY	CH2-NZ	2.18	1.52	1.46

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	713	MLY	CD-CG-CB	-2.46	104.34	113.62

There are no chirality outliers.

All (43) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	A	713	MLY	O-C-CA-CB
1	A	740	MLY	C-CA-CB-CG
1	A	740	MLY	O-C-CA-CB
1	A	775	MLY	C-CA-CB-CG
1	A	775	MLY	O-C-CA-CB
1	A	819	MLY	N-CA-CB-CG
1	A	819	MLY	C-CA-CB-CG
1	A	825	MLY	C-CA-CB-CG
1	A	842	MLY	C-CA-CB-CG
1	A	748	MLY	CD-CE-NZ-CH1
1	A	819	MLY	CG-CD-CE-NZ
1	A	825	MLY	CD-CE-NZ-CH2
1	A	713	MLY	CD-CE-NZ-CH2
1	A	740	MLY	CD-CE-NZ-CH2
1	A	748	MLY	CD-CE-NZ-CH2
1	A	819	MLY	CD-CE-NZ-CH2
1	A	747	MLY	CG-CD-CE-NZ
1	A	765	MLY	CD-CE-NZ-CH2
1	A	775	MLY	CG-CD-CE-NZ
1	A	748	MLY	CE-CD-CG-CB
1	A	819	MLY	CE-CD-CG-CB
1	A	713	MLY	CD-CE-NZ-CH1
1	A	791	MLY	CA-CB-CG-CD
1	A	842	MLY	CE-CD-CG-CB
1	A	747	MLY	CE-CD-CG-CB
1	A	740	MLY	CE-CD-CG-CB
1	A	787	MLY	CE-CD-CG-CB
1	A	775	MLY	CD-CE-NZ-CH1

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Mol	Chain	Res	Type	Atoms
1	A	842	MLY	CG-CD-CE-NZ
1	A	748	MLY	CG-CD-CE-NZ
1	A	842	MLY	CA-CB-CG-CD
1	A	825	MLY	CA-CB-CG-CD
1	A	819	MLY	CA-CB-CG-CD
1	A	791	MLY	CD-CE-NZ-CH2
1	A	713	MLY	C-CA-CB-CG
1	A	713	MLY	N-CA-CB-CG
1	A	740	MLY	N-CA-CB-CG
1	A	740	MLY	CG-CD-CE-NZ
1	A	825	MLY	CD-CE-NZ-CH1
1	A	747	MLY	CD-CE-NZ-CH2
1	A	791	MLY	C-CA-CB-CG
1	A	765	MLY	CA-CB-CG-CD
1	A	825	MLY	CE-CD-CG-CB

There are no ring outliers.

3 monomers are involved in 6 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
1	A	787	MLY	1	0
1	A	819	MLY	4	0
1	A	740	MLY	1	0

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

There are no ligands in this entry.

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, 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	141/334 (42%)	0.47	11 (7%) 19 16	38, 53, 70, 105	0

All (11) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	706	GLY	12.4
1	A	810	LYS	4.0
1	A	705	SER	3.5
1	A	728	THR	2.9
1	A	696	ASN	2.9
1	A	704	ASN	2.8
1	A	702	THR	2.5
1	A	700	THR	2.4
1	A	724	THR	2.3
1	A	746	ASP	2.3
1	A	697	ASN	2.1

6.2 Non-standard residues in protein, DNA, RNA chains [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(Å ²)	Q<0.9
1	MLY	A	748	11/12	0.82	0.22	59,62,71,72	0
1	MLY	A	787	11/12	0.83	0.19	52,57,70,71	0
1	MLY	A	775	11/12	0.84	0.19	46,52,59,60	0
1	MLY	A	765	11/12	0.84	0.16	55,57,60,61	0
1	MLY	A	825	11/12	0.85	0.19	52,55,63,63	0
1	MLY	A	713	11/12	0.86	0.16	53,55,61,61	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
1	MLY	A	740	11/12	0.88	0.17	57,61,63,63	0
1	MLY	A	747	11/12	0.89	0.19	67,69,76,77	0
1	MLY	A	842	11/12	0.90	0.17	47,53,59,59	0
1	MLY	A	791	11/12	0.91	0.14	48,50,57,57	0
1	MLY	A	819	11/12	0.93	0.14	48,49,52,52	0

6.3 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

6.4 Ligands [i](#)

There are no ligands in this entry.

6.5 Other polymers [i](#)

There are no such residues in this entry.