



Full wwPDB X-ray Structure Validation Report ⓘ

Apr 25, 2026 – 10:44 AM EDT

PDB ID : 4UP7 / pdb_00004up7
Title : Crystal structure of Entamoeba histolytica lysyl-tRNA synthetase in complex with lysyl-adenylate
Authors : Bonnefond, L.; Nureki, O.
Deposited on : 2014-06-14
Resolution : 2.79 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
Buster-report	:	wwPDB partial adaption of 1.1.7 (2018)
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

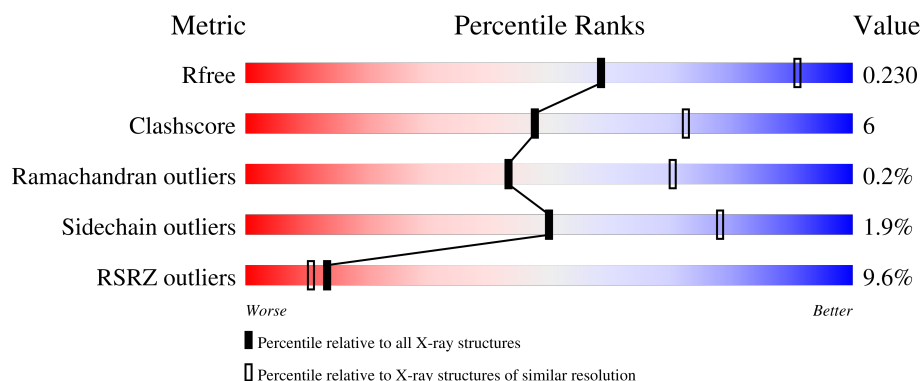
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.79 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	5248 (2.80-2.76)
Clashscore	190562	5693 (2.80-2.76)
Ramachandran outliers	187476	5590 (2.80-2.76)
Sidechain outliers	187428	5592 (2.80-2.76)
RSRZ outliers	180081	5251 (2.80-2.76)

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	777	

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 4271 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.

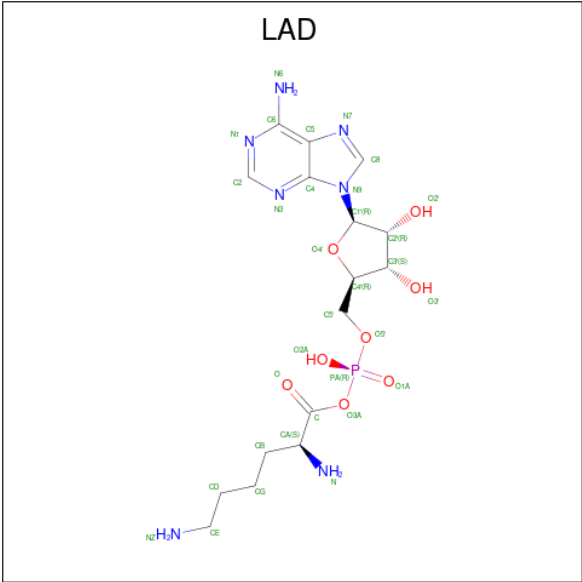
- Molecule 1 is a protein called LYSINE-TRNA LIGASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	529	Total	C	N	O	S	0	0	0
			4239	2703	722	789	25			

There are 10 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-7	MET	-	expression tag	UNP C4M7X2
A	-6	HIS	-	expression tag	UNP C4M7X2
A	-5	HIS	-	expression tag	UNP C4M7X2
A	-4	HIS	-	expression tag	UNP C4M7X2
A	-3	HIS	-	expression tag	UNP C4M7X2
A	-2	HIS	-	expression tag	UNP C4M7X2
A	-1	HIS	-	expression tag	UNP C4M7X2
A	0	MET	-	expression tag	UNP C4M7X2
A	1	LEU	-	expression tag	UNP C4M7X2
A	764	ILE	VAL	engineered mutation	UNP C4M7X2

- Molecule 2 is ADENOSINE-5'-[LYSYL-PHOSPHATE] (CCD ID: LAD) (formula: $C_{16}H_{26}N_7O_8P$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	N	O	P	0	0
			32	16	7	8	1		

4 Data and refinement statistics

Property	Value	Source
Space group	P 62	Depositor
Cell constants a, b, c, α , β , γ	155.76Å 155.76Å 95.29Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	36.05 – 2.79 36.05 – 2.79	Depositor EDS
% Data completeness (in resolution range)	99.5 (36.05-2.79) 99.5 (36.05-2.79)	Depositor EDS
R_{merge}	0.13	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.56 (at 2.81Å)	Xtriage
Refinement program	PHENIX (PHENIX.REFINE)	Depositor
R, R_{free}	0.205 , 0.225 0.211 , 0.230	Depositor DCC
R_{free} test set	1707 reflections (5.21%)	wwPDB-VP
Wilson B-factor (Å ²)	76.5	Xtriage
Anisotropy	0.002	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.28 , 54.3	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	0.034 for h,-h-k,-l	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	4271	wwPDB-VP
Average B, all atoms (Å ²)	86.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.51% 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: LAD

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	0.31	0/4329	0.77	5/5846 (0.1%)

There are no bond length outliers.

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	398	ARG	CA-C-N	-6.78	111.37	119.84
1	A	398	ARG	C-N-CA	-6.78	111.37	119.84
1	A	576	ALA	N-CA-C	-6.26	104.37	111.07
1	A	34	VAL	CA-C-N	-5.64	112.70	118.85
1	A	34	VAL	C-N-CA	-5.64	112.70	118.85

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	4239	0	4244	48	0
2	A	32	0	25	1	0
All	All	4271	0	4269	48	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 6.

All (48) 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:487:GLU:OE2	2:A:1584:LAD:NZ	2.19	0.75
1:A:505:LYS:HA	1:A:509:ASP:O	1.96	0.65
1:A:503:LYS:NZ	1:A:504:ASP:OD1	2.27	0.64
1:A:215:HIS:HB2	1:A:222:MET:HE2	1.79	0.63
1:A:510:ASP:N	1:A:511:GLU:OE1	2.34	0.59
1:A:396:ILE:HG22	1:A:397:PRO:O	2.03	0.58
1:A:303:LYS:N	1:A:369:LYS:O	2.33	0.57
1:A:300:LEU:HD21	1:A:370:LYS:HE3	1.86	0.57
1:A:511:GLU:OE1	1:A:511:GLU:N	2.36	0.57
1:A:410:LYS:NZ	1:A:424:GLN:OE1	2.37	0.57
1:A:383:SER:HB3	1:A:386:HIS:HB2	1.86	0.57
1:A:62:SER:HB3	1:A:74:ASP:HB2	1.86	0.56
1:A:420:CYS:HB3	1:A:424:GLN:HG2	1.86	0.56
1:A:569:ALA:O	1:A:573:LYS:HG2	2.07	0.55
1:A:389:GLU:HB3	1:A:395:LYS:HD2	1.90	0.54
1:A:1:LEU:HD23	1:A:575:ASP:HB3	1.92	0.52
1:A:-1:HIS:CG	1:A:571:GLU:HB3	2.44	0.52
1:A:500:GLN:O	1:A:503:LYS:HG2	2.11	0.50
1:A:156:ARG:NH2	1:A:560:ARG:O	2.29	0.50
1:A:-1:HIS:HA	1:A:575:ASP:OD2	2.12	0.49
1:A:496:SER:O	1:A:499:GLU:HB2	2.13	0.49
1:A:575:ASP:HA	1:A:578:VAL:HB	1.94	0.48
1:A:172:PHE:O	1:A:176:THR:HG23	2.12	0.48
1:A:401:ASP:OD1	1:A:401:ASP:N	2.39	0.46
1:A:144:MET:HA	1:A:145:HIS:HA	1.61	0.46
1:A:503:LYS:HG3	1:A:504:ASP:N	2.29	0.46
1:A:389:GLU:HG2	1:A:395:LYS:HA	1.98	0.46
1:A:535:LEU:HD11	1:A:540:LEU:HD22	1.98	0.45
1:A:255:ILE:HG12	1:A:261:PRO:HD3	1.98	0.45
1:A:297:SER:OG	1:A:376:THR:HG22	2.17	0.45
1:A:510:ASP:N	1:A:510:ASP:OD1	2.51	0.44
1:A:462:HIS:HA	1:A:470:GLU:HG3	1.99	0.44
1:A:18:LYS:HB2	1:A:18:LYS:HE2	1.77	0.44
1:A:120:LYS:HE2	1:A:120:LYS:HB3	1.82	0.44
1:A:415:ARG:HH11	1:A:415:ARG:HG3	1.83	0.43
1:A:391:LYS:HZ3	1:A:437:LEU:HB3	1.84	0.43
1:A:260:ASN:OD1	1:A:261:PRO:HD2	2.19	0.42
1:A:209:ARG:NH1	1:A:510:ASP:OD2	2.52	0.42
1:A:410:LYS:HZ2	1:A:410:LYS:HG2	1.64	0.42
1:A:34:VAL:HG22	1:A:35:PRO:HD3	2.00	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:22:ASN:HA	1:A:23:PRO:HD3	1.90	0.41
1:A:567:LYS:O	1:A:571:GLU:HG3	2.21	0.41
1:A:391:LYS:HE2	1:A:437:LEU:HB3	2.02	0.41
1:A:514:LEU:HD23	1:A:515:VAL:N	2.34	0.41
1:A:152:GLU:OE1	1:A:156:ARG:NE	2.52	0.41
1:A:174:LEU:HD11	1:A:544:LEU:HB2	2.03	0.41
1:A:-6:HIS:HB2	1:A:-5:HIS:HA	2.03	0.41
1:A:268:PHE:CD1	1:A:268:PHE:C	2.99	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	525/777 (68%)	490 (93%)	34 (6%)	1 (0%)	43 70

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	526	ALA

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	466/679 (69%)	457 (98%)	9 (2%)	50 78

All (9) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	18	LYS
1	A	391	LYS
1	A	414	ILE
1	A	453	GLN
1	A	480	GLU
1	A	515	VAL
1	A	559	MET
1	A	567	LYS
1	A	575	ASP

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (6) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	-1	HIS
1	A	21	HIS
1	A	87	ASN
1	A	115	HIS
1	A	214	HIS
1	A	257	GLN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

There are no non-standard protein/DNA/RNA residues in this entry.

5.5 Carbohydrates ⓘ

There are no oligosaccharides in this entry.

5.6 Ligand geometry

1 ligand is 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	LAD	A	1584	-	33,34,34	0.75	0	45,49,49	1.80	9 (20%)

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	LAD	A	1584	-	-	6/22/40/40	0/3/3/3

There are no bond length outliers.

All (9) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	1584	LAD	C5-C4-N3	-5.57	119.05	126.72
2	A	1584	LAD	N3-C4-N9	4.51	134.84	127.17
2	A	1584	LAD	N1-C2-N3	-4.01	122.51	128.58
2	A	1584	LAD	C5-N7-C8	3.82	109.45	103.45
2	A	1584	LAD	C2-N3-C4	3.63	120.70	111.83
2	A	1584	LAD	C4-C5-N7	-3.09	107.05	110.58
2	A	1584	LAD	N9-C8-N7	-2.74	110.05	113.94
2	A	1584	LAD	PA-O5'-C5'	-2.47	107.17	121.35
2	A	1584	LAD	O3A-PA-O5'	2.43	110.31	103.00

There are no chirality outliers.

All (6) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	1584	LAD	C-CA-CB-CG

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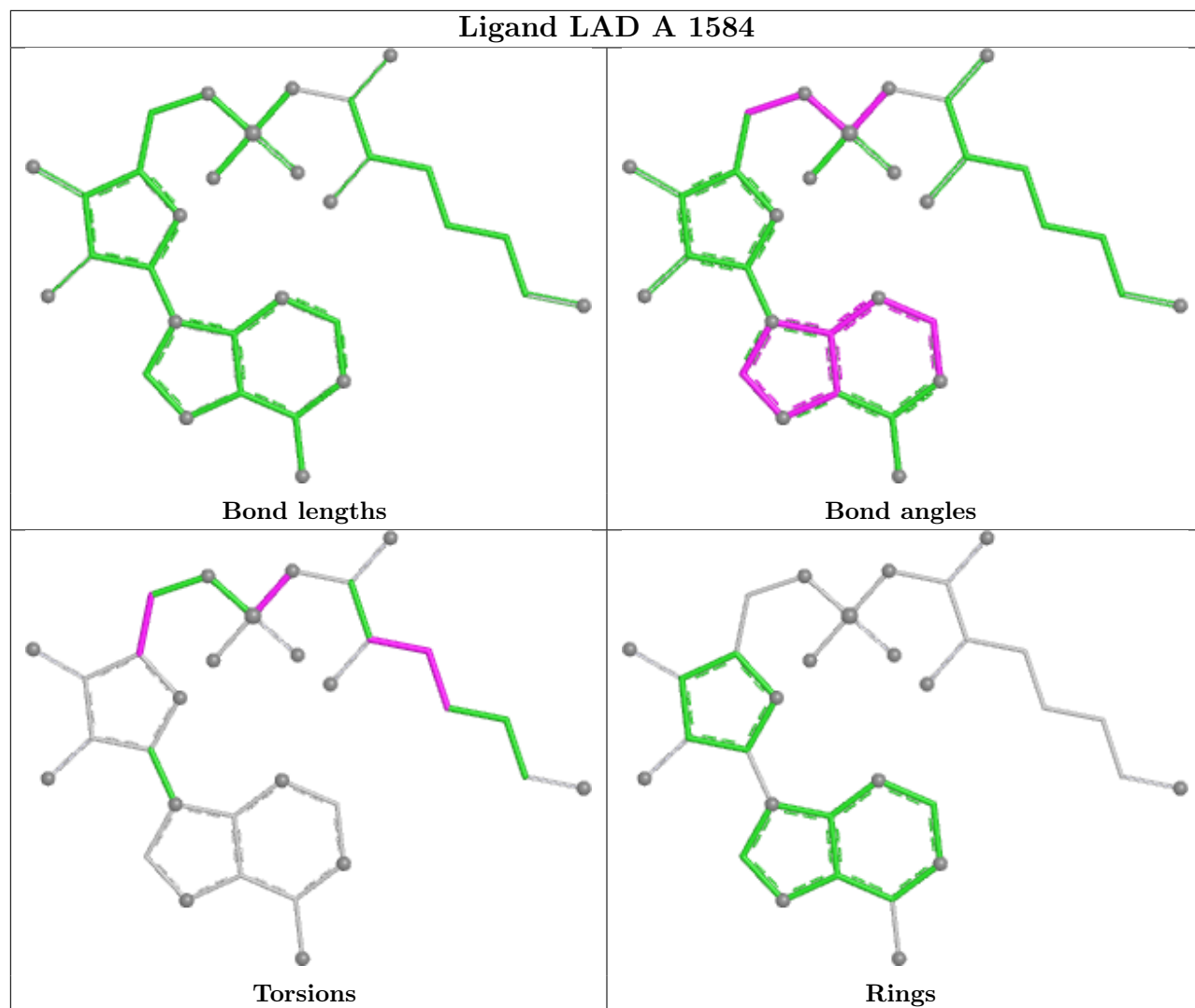
Mol	Chain	Res	Type	Atoms
2	A	1584	LAD	O4'-C4'-C5'-O5'
2	A	1584	LAD	C3'-C4'-C5'-O5'
2	A	1584	LAD	N-CA-CB-CG
2	A	1584	LAD	CA-CB-CG-CD
2	A	1584	LAD	C-O3A-PA-O1A

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	1584	LAD	1	0

The following is a two-dimensional graphical depiction of Mogul quality analysis of bond lengths, bond angles, torsion angles, and ring geometry for all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the validation Tables will also be included. For torsion angles, if less than 5% of the Mogul distribution of torsion angles is within 10 degrees of the torsion angle in question, then that torsion angle is considered an outlier. Any bond that is central to one or more torsion angles identified as an outlier by Mogul will be highlighted in the graph. For rings, the root-mean-square deviation (RMSD) between the ring in question and similar rings identified by Mogul is calculated over all ring torsion angles. If the average RMSD is greater than 60 degrees and the minimal RMSD between the ring in question and any Mogul-identified rings is also greater than 60 degrees, then that ring is considered an outlier. The outliers are highlighted in purple. The color gray indicates Mogul did not find sufficient equivalents in the CSD to analyse the geometry.



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	529/777 (68%)	0.40	51 (9%) 13 11	43, 76, 153, 204	0

All (51) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	366	VAL	6.7
1	A	461	TYR	5.2
1	A	399	PRO	4.5
1	A	-4	HIS	4.5
1	A	365	PHE	4.4
1	A	511	GLU	3.9
1	A	-6	HIS	3.9
1	A	300	LEU	3.8
1	A	583	ALA	3.8
1	A	367	THR	3.6
1	A	418	ALA	3.4
1	A	397	PRO	3.4
1	A	403	PRO	3.4
1	A	581	GLU	3.2
1	A	514	LEU	3.2
1	A	405	ALA	3.1
1	A	-5	HIS	2.9
1	A	453	GLN	2.9
1	A	380	LYS	2.9
1	A	408	PHE	2.8
1	A	301	GLU	2.8
1	A	204	GLY	2.8
1	A	369	LYS	2.8
1	A	149	GLY	2.7
1	A	145	HIS	2.7
1	A	580	GLN	2.7
1	A	146	TYR	2.6

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Mol	Chain	Res	Type	RSRZ
1	A	419	ILE	2.6
1	A	454	LEU	2.6
1	A	207	THR	2.5
1	A	296	GLY	2.5
1	A	292	ASP	2.4
1	A	575	ASP	2.3
1	A	299	LYS	2.3
1	A	398	ARG	2.3
1	A	512	ALA	2.3
1	A	-3	HIS	2.2
1	A	253	GLU	2.2
1	A	401	ASP	2.2
1	A	295	GLY	2.2
1	A	148	LEU	2.2
1	A	49	VAL	2.2
1	A	467	GLU	2.1
1	A	420	CYS	2.1
1	A	298	THR	2.1
1	A	414	ILE	2.1
1	A	374	ASP	2.1
1	A	392	PHE	2.1
1	A	303	LYS	2.0
1	A	205	GLY	2.0
1	A	515	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](#)

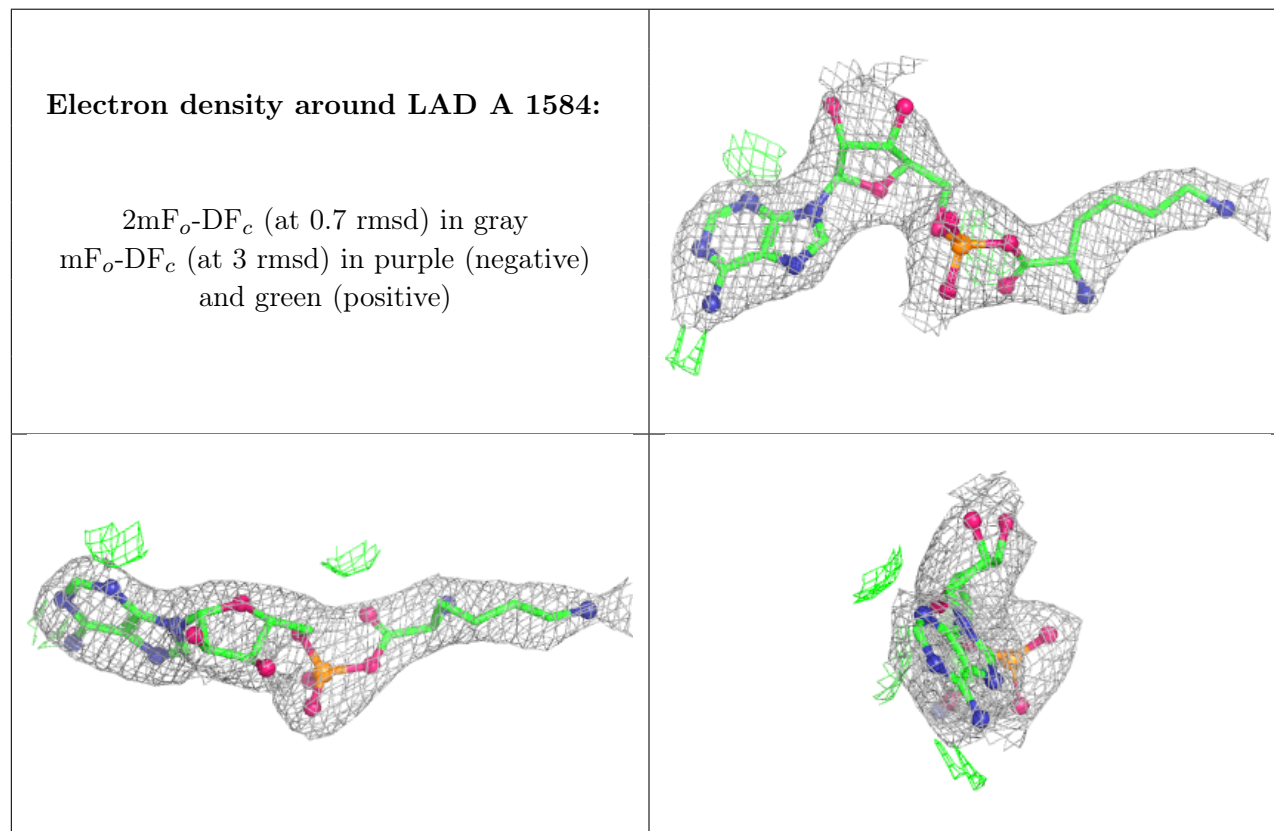
There are no oligosaccharides in this entry.

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, 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($\text{\AA}^2$)	Q<0.9
2	LAD	A	1584	32/32	0.95	0.11	59,77,106,114	32

The following is a graphical depiction of the model fit to experimental electron density of all instances of the Ligand of Interest. In addition, ligands with molecular weight > 250 and outliers as shown on the geometry validation Tables will also be included. Each fit is shown from different orientation to approximate a three-dimensional view.



6.5 Other polymers ⓘ

There are no such residues in this entry.