



# Full wwPDB X-ray Structure Validation Report i

Dec 28, 2025 – 06:14 PM EST

PDB ID : 9ZM0 / pdb\_00009zm0  
Title : Crystal structure of monomeric Atg23  
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Deposited on : 2025-12-09  
Resolution : 2.10 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 i 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](#) i) 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 : 20231227.v01 (using entries in the PDB archive December 27th 2023)  
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) : 2.47

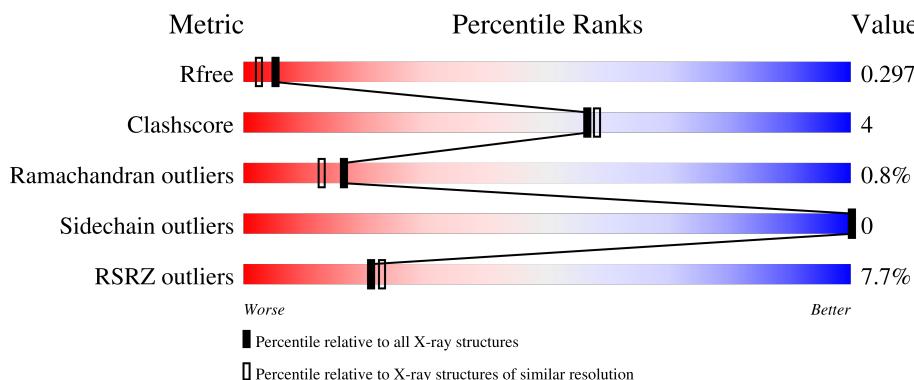
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## X-RAY DIFFRACTION

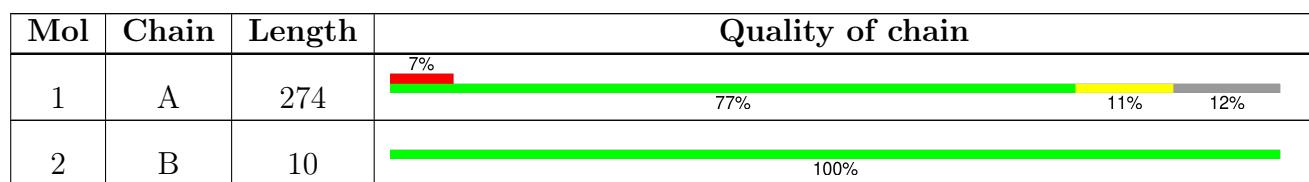
The reported resolution of this entry is 2.10 Å.

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))
$R_{free}$	164625	6234 (2.10-2.10)
Clashscore	180529	6893 (2.10-2.10)
Ramachandran outliers	177936	6839 (2.10-2.10)
Sidechain outliers	177891	6840 (2.10-2.10)
RSRZ outliers	164620	6234 (2.10-2.10)

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.



## 2 Entry composition (i)

There are 3 unique types of molecules in this entry. The entry contains 2101 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 Autophagy-related protein 23.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	N	O	S	Se			
1	A	242	1951	1206	342	392	4	7	0	0	0

There are 9 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1	GLY	-	expression tag	UNP Q06671
A	2	ALA	-	expression tag	UNP Q06671
A	3	MSE	-	expression tag	UNP Q06671
A	4	GLY	-	expression tag	UNP Q06671
A	5	SER	-	expression tag	UNP Q06671
A	101	ALA	-	linker	UNP Q06671
A	102	ASN	-	linker	UNP Q06671
A	103	ASN	-	linker	UNP Q06671
A	104	SER	-	linker	UNP Q06671

- Molecule 2 is a protein called unidentified Atg23 fragment.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
			Total	C	N	O			
2	B	10	50	30	10	10	0	0	0

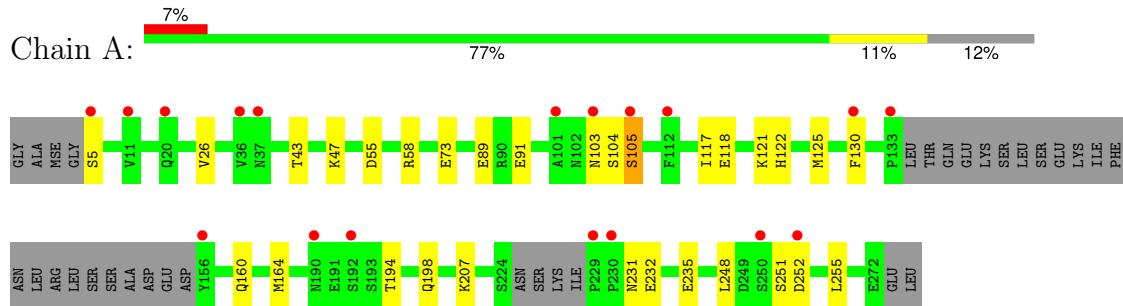
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
3	A	100	100	100	0	0

### 3 Residue-property plots

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: Autophagy-related protein 23



- Molecule 2: unidentified Atg23 fragment



There are no outlier residues recorded for this chain.

## 4 Data and refinement statistics i

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	50.41Å 30.10Å 91.24Å 90.00° 97.15° 90.00°	Depositor
Resolution (Å)	46.29 – 2.10 46.29 – 2.10	Depositor EDS
% Data completeness (in resolution range)	99.9 (46.29-2.10) 99.9 (46.29-2.10)	Depositor EDS
$R_{merge}$	0.12	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle^1$	1.76 (at 2.10Å)	Xtriage
Refinement program	PHENIX 1.14_3260	Depositor
$R$ , $R_{free}$	0.238, 0.298 0.239, 0.297	Depositor DCC
$R_{free}$ test set	801 reflections (4.90%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	36.0	Xtriage
Anisotropy	0.229	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.37, 75.0	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.51$ , $\langle L^2 \rangle = 0.34$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	2101	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	53.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 16.83% 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

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	0.16	0/1958	0.33	0/2610

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	1951	0	1984	18	0
2	B	50	0	12	0	0
3	A	100	0	0	2	0
All	All	2101	0	1996	18	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 4.

All (18) 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:125:MSE:HB3	1:A:130:PHE:HB3	1.73	0.70
1:A:232:GLU:HA	1:A:235:GLU:HG2	1.85	0.57
1:A:43:THR:HG22	1:A:47:LYS:HE2	1.88	0.54

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:207:LYS:NZ	3:A:302:HOH:O	2.32	0.53
1:A:248:LEU:HA	1:A:251:SER:HB3	1.92	0.52
1:A:5:SER:HB3	1:A:73:GLU:OE1	2.10	0.51
1:A:26:VAL:HG21	1:A:255:LEU:HG	1.94	0.50
1:A:194:THR:O	1:A:198:GLN:HG2	2.12	0.49
1:A:103:ASN:O	1:A:105:SER:N	2.45	0.49
1:A:91:GLU:HG3	1:A:117:ILE:HG21	1.96	0.48
1:A:55:ASP:OD1	1:A:58:ARG:NH2	2.48	0.46
1:A:121:LYS:O	1:A:125:MSE:HG3	2.17	0.45
1:A:252:ASP:OD1	1:A:252:ASP:N	2.45	0.43
1:A:122:HIS:ND1	1:A:125:MSE:HE2	2.33	0.43
1:A:231:ASN:O	1:A:235:GLU:HG2	2.20	0.42
1:A:89:GLU:OE1	3:A:301:HOH:O	2.22	0.42
1:A:160:GLN:O	1:A:164:MSE:HG3	2.19	0.41
1:A:118:GLU:HA	1:A:121:LYS:HB2	2.03	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	236/274 (86%)	228 (97%)	6 (2%)	2 (1%)	16 13

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	104	SER
1	A	105	SER

### 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	230/250 (92%)	230 (100%)	0	100   100

There are no protein residues with a non-rotameric sidechain to report.

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	17	GLN
1	A	20	GLN
1	A	160	GLN
1	A	206	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 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

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	234/274 (85%)	0.69	18 (7%) <span style="background-color: red; border: 1px solid red; padding: 2px;">21</span> <span style="background-color: red; border: 1px solid red; padding: 2px;">23</span>	23, 48, 85, 107	0
2	B	0/10	-	-	-	-
All	All	234/284 (82%)	0.69	18 (7%) <span style="background-color: red; border: 1px solid red; padding: 2px;">21</span> <span style="background-color: red; border: 1px solid red; padding: 2px;">23</span>	23, 48, 85, 107	0

All (18) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	133	PRO	4.4
1	A	36	VAL	4.1
1	A	112	PHE	4.0
1	A	252	ASP	3.0
1	A	229	PRO	2.9
1	A	156	TYR	2.9
1	A	230	PRO	2.8
1	A	20	GLN	2.8
1	A	5	SER	2.6
1	A	190	ASN	2.6
1	A	101	ALA	2.5
1	A	37	ASN	2.4
1	A	103	ASN	2.3
1	A	130	PHE	2.2
1	A	192	SER	2.1
1	A	105	SER	2.1
1	A	250	SER	2.1
1	A	11	VAL	2.1

### 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 [\(i\)](#)

There are no ligands in this entry.

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

There are no such residues in this entry.