



# wwPDB X-ray Structure Validation Summary Report ⓘ

May 18, 2026 – 04:29 pm BST

PDB ID : 9QNM / pdb\_00009qnm  
Title : Polyester Hydrolase Leipzig 7 (PHL7) variant R2M2  
Authors : Useini, A.; Strater, N.; Kuenze, G.; Sonnendecker, C.  
Deposited on : 2025-03-25  
Resolution : 1.12 Å(reported)

This is a wwPDB X-ray Structure Validation Summary Report for a publicly released PDB entry.

We welcome your comments at [validation@mail.wwpdb.org](mailto:validation@mail.wwpdb.org)

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<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	:	4-5-2 with Phenix2.0
Mogul	:	1.8.4, CSD as541be (2020)
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

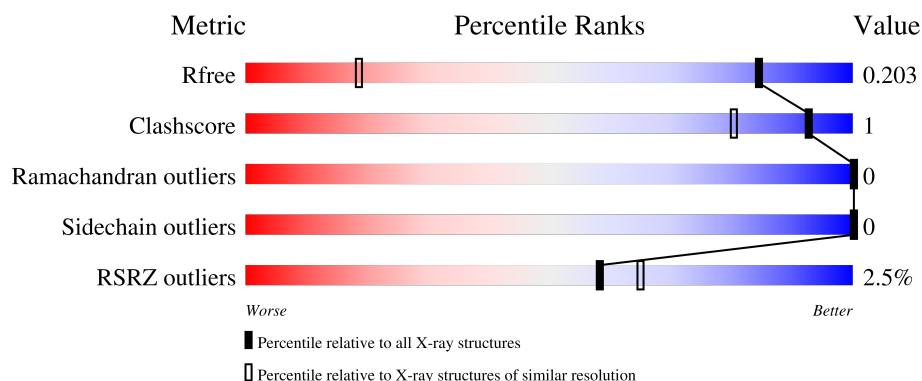
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 1.12 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	1985 (1.14-1.10)
Clashscore	190562	2021 (1.14-1.10)
Ramachandran outliers	187476	1978 (1.14-1.10)
Sidechain outliers	187428	1974 (1.14-1.10)
RSRZ outliers	180081	1984 (1.14-1.10)

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.

Mol	Chain	Length	Quality of chain
1	A	267	<div> <div>2%</div> <div> <div></div> <div>95%</div> <div></div> </div> <div></div> </div>
1	B	267	<div> <div>3%</div> <div> <div></div> <div>94%</div> <div></div> </div> <div></div> </div>

## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 8879 atoms, of which 4007 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 Polyester Hydrolase Leipzig 7 (PHL-7), catalysis-deficient S131A mutant.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	262	Total	C	H	N	O	S	0	14	0
			4033	1280	1996	354	397	6			
1	B	260	Total	C	H	N	O	S	0	15	0
			4032	1279	2001	348	398	6			

There are 60 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	6	GLN	GLU	engineered mutation	UNP A0AA82WPD4
A	34	ASP	GLN	engineered mutation	UNP A0AA82WPD4
A	36	SER	ASP	engineered mutation	UNP A0AA82WPD4
A	68	SER	GLU	engineered mutation	UNP A0AA82WPD4
A	91	SER	THR	engineered mutation	UNP A0AA82WPD4
A	104	LEU	GLN	engineered mutation	UNP A0AA82WPD4
A	109	TYR	HIS	engineered mutation	UNP A0AA82WPD4
A	111	THR	ARG	engineered mutation	UNP A0AA82WPD4
A	113	ASP	ASN	engineered mutation	UNP A0AA82WPD4
A	115	THR	VAL	engineered mutation	UNP A0AA82WPD4
A	118	ASP	ASN	engineered mutation	UNP A0AA82WPD4
A	131	SER	ALA	engineered mutation	UNP A0AA82WPD4
A	145	PRO	THR	engineered mutation	UNP A0AA82WPD4
A	148	LYS	GLU	engineered mutation	UNP A0AA82WPD4
A	155	PRO	GLY	engineered mutation	UNP A0AA82WPD4
A	161	ASP	ASN	engineered mutation	UNP A0AA82WPD4
A	167	VAL	THR	engineered mutation	UNP A0AA82WPD4
A	171	ILE	VAL	engineered mutation	UNP A0AA82WPD4
A	186	ALA	SER	engineered mutation	UNP A0AA82WPD4
A	196	SER	ASP	engineered mutation	UNP A0AA82WPD4
A	198	PRO	ASP	engineered mutation	UNP A0AA82WPD4
A	208	ASP	SER	engineered mutation	UNP A0AA82WPD4
A	216	ASN	ASP	engineered mutation	UNP A0AA82WPD4
A	235	THR	LEU	engineered mutation	UNP A0AA82WPD4

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Chain	Residue	Modelled	Actual	Comment	Reference
A	248	PRO	PHE	engineered mutation	UNP A0AA82WPD4
A	263	HIS	-	expression tag	UNP A0AA82WPD4
A	264	HIS	-	expression tag	UNP A0AA82WPD4
A	265	HIS	-	expression tag	UNP A0AA82WPD4
A	266	HIS	-	expression tag	UNP A0AA82WPD4
A	267	HIS	-	expression tag	UNP A0AA82WPD4
B	6	GLN	GLU	engineered mutation	UNP A0AA82WPD4
B	34	ASP	GLN	engineered mutation	UNP A0AA82WPD4
B	36	SER	ASP	engineered mutation	UNP A0AA82WPD4
B	68	SER	GLU	engineered mutation	UNP A0AA82WPD4
B	91	SER	THR	engineered mutation	UNP A0AA82WPD4
B	104	LEU	GLN	engineered mutation	UNP A0AA82WPD4
B	109	TYR	HIS	engineered mutation	UNP A0AA82WPD4
B	111	THR	ARG	engineered mutation	UNP A0AA82WPD4
B	113	ASP	ASN	engineered mutation	UNP A0AA82WPD4
B	115	THR	VAL	engineered mutation	UNP A0AA82WPD4
B	118	ASP	ASN	engineered mutation	UNP A0AA82WPD4
B	131	SER	ALA	engineered mutation	UNP A0AA82WPD4
B	145	PRO	THR	engineered mutation	UNP A0AA82WPD4
B	148	LYS	GLU	engineered mutation	UNP A0AA82WPD4
B	155	PRO	GLY	engineered mutation	UNP A0AA82WPD4
B	161	ASP	ASN	engineered mutation	UNP A0AA82WPD4
B	167	VAL	THR	engineered mutation	UNP A0AA82WPD4
B	171	ILE	VAL	engineered mutation	UNP A0AA82WPD4
B	186	ALA	SER	engineered mutation	UNP A0AA82WPD4
B	196	SER	ASP	engineered mutation	UNP A0AA82WPD4
B	198	PRO	ASP	engineered mutation	UNP A0AA82WPD4
B	208	ASP	SER	engineered mutation	UNP A0AA82WPD4
B	216	ASN	ASP	engineered mutation	UNP A0AA82WPD4
B	235	THR	LEU	engineered mutation	UNP A0AA82WPD4
B	248	PRO	PHE	engineered mutation	UNP A0AA82WPD4
B	263	HIS	-	expression tag	UNP A0AA82WPD4
B	264	HIS	-	expression tag	UNP A0AA82WPD4
B	265	HIS	-	expression tag	UNP A0AA82WPD4
B	266	HIS	-	expression tag	UNP A0AA82WPD4
B	267	HIS	-	expression tag	UNP A0AA82WPD4

- Molecule 2 is CITRIC ACID (CCD ID: CIT) (formula: C<sub>6</sub>H<sub>8</sub>O<sub>7</sub>).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	A	1	Total	C	H	O	0	0
			18	6	5	7		
2	B	1	Total	C	H	O	0	0
			18	6	5	7		

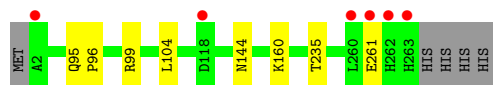
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	386	Total	O	0	15
			397	397		
3	B	371	Total	O	0	14
			381	381		

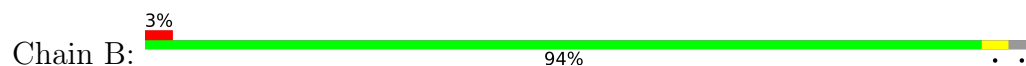
### 3 Residue-property plots [i](#)

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: Polyester Hydrolase Leipzig 7 (PHL-7), catalysis-deficient S131A mutant



- Molecule 1: Polyester Hydrolase Leipzig 7 (PHL-7), catalysis-deficient S131A mutant



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	52.26Å 74.10Å 63.60Å 90.00° 97.14° 90.00°	Depositor
Resolution (Å)	63.10 – 1.12 63.10 – 1.12	Depositor EDS
% Data completeness (in resolution range)	53.6 (63.10-1.12) 53.9 (63.10-1.12)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.20 (at 1.12Å)	Xtriage
Refinement program	PHENIX (1.20.1_4487)	Depositor
R, $R_{free}$	0.172 , 0.203 0.172 , 0.203	Depositor DCC
$R_{free}$ test set	2561 reflections (1.38%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	10.0	Xtriage
Anisotropy	0.130	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.40 , 45.4	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.51$ , $\langle L^2 \rangle = 0.35$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.96	EDS
Total number of atoms	8879	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	14.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 11.07% 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: CIT

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	0/2138	0.60	0/2921
1	B	0.49	0/2124	0.60	0/2906
All	All	0.50	0/4262	0.60	0/5827

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	1

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	99	ARG	Sidechain

### 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	2037	1996	1973	6	0
1	B	2031	2001	1995	6	0
2	A	13	5	5	0	0
2	B	13	5	5	0	0
3	A	397	0	0	1	0
3	B	381	0	0	4	0
All	All	4872	4007	3978	12	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 1.

The worst 5 of 12 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:B:104[B]:LEU:HD23	3:B:704:HOH:O	1.90	0.71
1:B:183:SER:OG	3:B:401:HOH:O	2.10	0.70
1:A:104[B]:LEU:HD13	1:A:144[B]:ASN:HD22	1.78	0.48
1:A:235:THR:HG21	1:A:261:GLU:CD	2.39	0.47
1:A:104[A]:LEU:HD11	1:A:144[A]:ASN:OD1	2.17	0.44

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	274/267 (103%)	269 (98%)	5 (2%)	0	100	100
1	B	273/267 (102%)	270 (99%)	3 (1%)	0	100	100
All	All	547/534 (102%)	539 (98%)	8 (2%)	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	226/218 (104%)	226 (100%)	0	100	100
1	B	226/218 (104%)	226 (100%)	0	100	100
All	All	452/436 (104%)	452 (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	95	GLN
1	A	123	ASN
1	B	67	GLN
1	B	239	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](#)

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	CIT	B	301	-	12,12,12	0.76	0	17,17,17	1.56	2 (11%)
2	CIT	A	301	-	12,12,12	0.90	0	17,17,17	1.55	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	CIT	B	301	-	-	2/16/16/16	-
2	CIT	A	301	-	-	4/16/16/16	-

There are no bond length outliers.

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	301	CIT	O5-C6-C3	-4.47	115.93	122.25
2	A	301	CIT	O5-C6-C3	-3.96	116.65	122.25
2	A	301	CIT	O1-C1-C2	-2.41	115.90	122.94
2	B	301	CIT	O1-C1-C2	-2.36	116.06	122.94

There are no chirality outliers.

5 of 6 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	301	CIT	O1-C1-C2-C3
2	A	301	CIT	O2-C1-C2-C3
2	B	301	CIT	O1-C1-C2-C3
2	B	301	CIT	O2-C1-C2-C3
2	A	301	CIT	C3-C4-C5-O3

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 [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	262/267 (98%)	-0.11	6 (2%) 61 67	5, 11, 20, 65	11 (4%)
1	B	260/267 (97%)	-0.02	7 (2%) 56 62	5, 12, 23, 48	14 (5%)
All	All	522/534 (97%)	-0.07	13 (2%) 58 65	5, 11, 21, 65	25 (4%)

The worst 5 of 13 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	245	PRO	4.5
1	B	260	LEU	3.9
1	B	246	ASP	3.4
1	A	262	HIS	2.9
1	A	263	HIS	2.6

### 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, 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	CIT	B	301	13/13	0.85	0.10	19,19,23,23	0
2	CIT	A	301	13/13	0.88	0.09	19,19,23,23	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.