



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 5, 2026 – 05:06 PM UTC

PDB ID : 7CWI / pdb_00007cwi
Title : Crystal structure of beta-galactosidase II from *Bacillus circulans*
Authors : Hong, H.; Seo, H.
Deposited on : 2020-08-28
Resolution : 1.95 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

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:

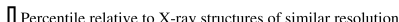
MolProbity : 4-5-2 with Phenix2.0
Mogul : 2022.3.0, CSD as543be (2022)
Xtriage (Phenix) : 2.0
EDS : 3.0
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4 : 9.0.010 (Gargrove)
Density-Fitness : 1.0.12
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.49

i

X-RAY DIFFRACTION

A.

Metric	Percentile Rank	Value
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Similar resolution
(#Entries, resolution range(Å))

Mol	Chain	Length	Quality of chain
1	A	815	% 86% 12% ..

2 Entry composition [i](#)

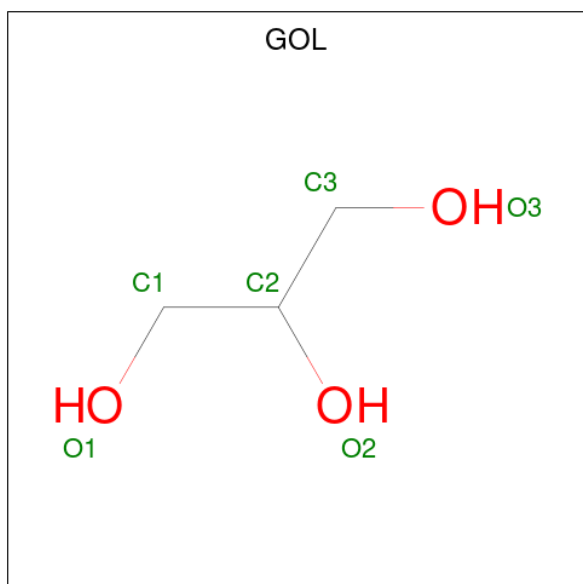
There are 5 unique types of molecules in this entry. The entry contains 7137 atoms, of which 0 are hydrogens and 0 are deuteriums.

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 beta-galactosidase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	803	6419	4060	1096	1250	13	0	4	0

- Molecule 2 is GLYCEROL (CCD ID: GOL) (formula: $C_3H_8O_3$).



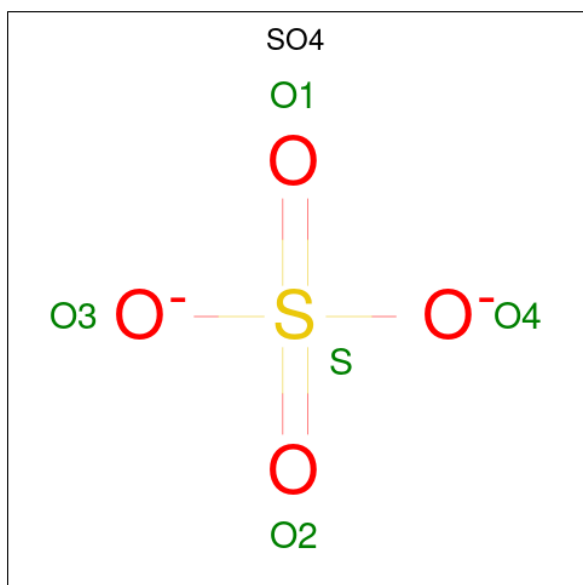
Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	C	O	0	0
			6	3	3		
2	A	1	Total	C	O	0	0
			6	3	3		
2	A	1	Total	C	O	0	0
			6	3	3		
2	A	1	Total	C	O	0	0
			6	3	3		
2	A	1	Total	C	O	0	0
			6	3	3		

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Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
2	A	1	Total	C	O	0	0
			6	3	3		
2	A	1	Total	C	O	0	0
			6	3	3		

- Molecule 3 is SULFATE ION (CCD ID: SO4) (formula: O₄S).



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

- Molecule 4 is CHLORIDE ION (CCD ID: CL) (formula: Cl).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	1	Total	Cl	0	0
			1	1		

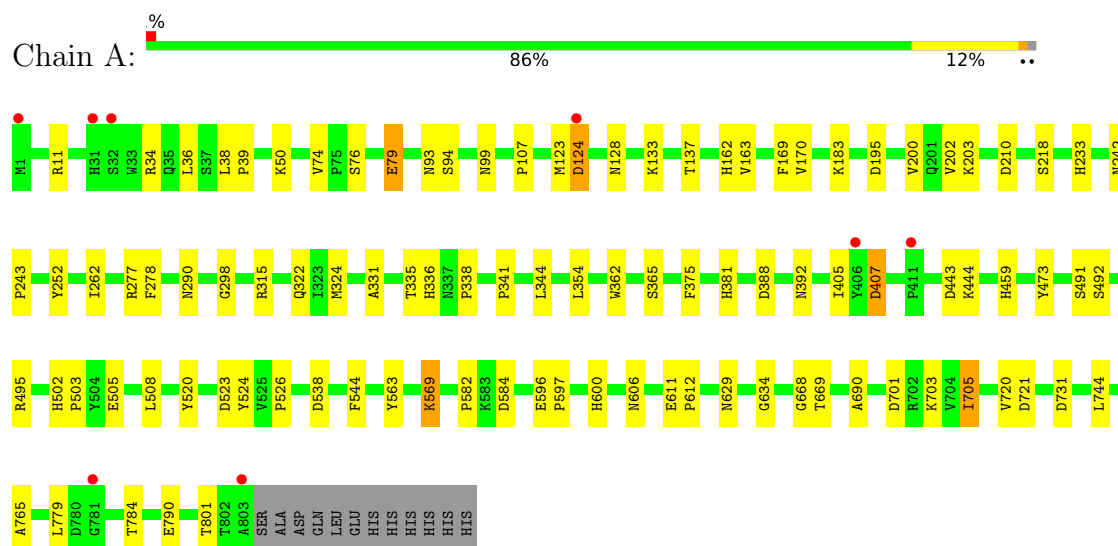
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	645	Total 645	O 645	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: beta-galactosidase



4 Data and refinement statistics

Property	Value	Source
Space group	P 32 2 1	Depositor
Cell constants a, b, c, α , β , γ	159.80Å 159.80Å 96.17Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	31.77 – 1.95 31.77 – 1.95	Depositor EDS
% Data completeness (in resolution range)	99.2 (31.77-1.95) 99.2 (31.77-1.95)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	6.56 (at 1.95Å)	Xtriage
Refinement program	REFMAC 5.8.0253	Depositor
R, R_{free}	0.156 , 0.187 0.167 , 0.193	Depositor DCC
R_{free} test set	5030 reflections (4.92%)	wwPDB-VP
Wilson B-factor (Å ²)	24.3	Xtriage
Anisotropy	0.017	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.37 , 45.4	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.30$	Xtriage
Estimated twinning fraction	0.024 for -h,-k,l	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	7137	wwPDB-VP
Average B, all atoms (Å ²)	28.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.67% 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

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: GOL, SO4, CL

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	1.15	9/6588 (0.1%)	1.26	10/8951 (0.1%)

The worst 5 of 9 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	354	LEU	C-O	6.34	1.30	1.23
1	A	612	PRO	C-O	-6.21	1.16	1.23
1	A	341	PRO	C-O	-6.10	1.16	1.24
1	A	720	VAL	C-O	5.41	1.30	1.23
1	A	721	ASP	C-O	5.33	1.30	1.23

The worst 5 of 10 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	563	TYR	CA-C-N	-11.95	107.02	123.03
1	A	563	TYR	C-N-CA	-11.95	107.02	123.03
1	A	124	ASP	CB-CA-C	-6.57	101.20	111.39
1	A	701	ASP	CA-CB-CG	6.51	119.11	112.60
1	A	407	ASP	CA-CB-CG	6.49	119.09	112.60

There are no chirality outliers.

There are no planarity outliers.

5.2 Too-close contacts

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	6419	0	6126	61	0
2	A	42	0	56	5	0
3	A	30	0	0	0	0
4	A	1	0	0	1	0
5	A	645	0	0	6	0
All	All	7137	0	6182	62	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 5.

The worst 5 of 62 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:606:ASN:HD21	1:A:690:ALA:H	1.17	0.93
1:A:629:ASN:HD21	1:A:668:GLY:HA3	1.44	0.83
1:A:162:HIS:HE1	1:A:195:ASP:OD2	1.63	0.81
1:A:233:HIS:NE2	2:A:907:GOL:H11	2.00	0.77
1:A:76:SER:O	1:A:79:GLU:HG3	1.91	0.71

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	805/815 (99%)	777 (96%)	27 (3%)	1 (0%)	48 41

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	491	SER

5.3.2 Protein sidechains ⓘ

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	683/690 (99%)	672 (98%)	11 (2%)	55 52

5 of 11 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	569	LYS
1	A	611	GLU
1	A	790	GLU
1	A	779	LEU
1	A	407	ASP

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 18 such sidechains are listed below:

Mol	Chain	Res	Type
1	A	600	HIS
1	A	775	GLN
1	A	629	ASN
1	A	364	GLN
1	A	517	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

Of 14 ligands modelled in this entry, 1 is monoatomic - leaving 13 for Mogul analysis.

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	GOL	A	901	-	5,5,5	0.14	0	5,5,5	0.40	0
3	SO4	A	908	-	4,4,4	0.23	0	6,6,6	0.35	0
3	SO4	A	911	-	4,4,4	0.30	0	6,6,6	0.22	0
3	SO4	A	913	-	4,4,4	0.27	0	6,6,6	0.13	0
2	GOL	A	906	-	5,5,5	0.30	0	5,5,5	0.41	0
2	GOL	A	907	-	5,5,5	0.27	0	5,5,5	0.72	0
2	GOL	A	905	-	5,5,5	0.13	0	5,5,5	0.31	0
2	GOL	A	904	-	5,5,5	0.40	0	5,5,5	1.05	0
2	GOL	A	903	-	5,5,5	0.29	0	5,5,5	0.74	0
2	GOL	A	902	-	5,5,5	0.44	0	5,5,5	1.15	1 (20%)
3	SO4	A	912	-	4,4,4	0.33	0	6,6,6	0.12	0
3	SO4	A	910	-	4,4,4	0.35	0	6,6,6	0.41	0
3	SO4	A	909	-	4,4,4	0.31	0	6,6,6	0.21	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
2	GOL	A	901	-	-	0/4/4/4	-
2	GOL	A	906	-	-	0/4/4/4	-
2	GOL	A	907	-	-	4/4/4/4	-
2	GOL	A	905	-	-	4/4/4/4	-
2	GOL	A	904	-	-	1/4/4/4	-
2	GOL	A	903	-	-	2/4/4/4	-
2	GOL	A	902	-	-	4/4/4/4	-

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed($^{\circ}$)	Ideal($^{\circ}$)
2	A	902	GOL	O2-C2-C1	2.03	117.60	109.18

There are no chirality outliers.

5 of 15 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	A	902	GOL	C1-C2-C3-O3
2	A	903	GOL	O1-C1-C2-C3
2	A	905	GOL	O1-C1-C2-C3
2	A	907	GOL	O1-C1-C2-C3
2	A	902	GOL	O2-C2-C3-O3

There are no ring outliers.

3 monomers are involved in 5 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	907	GOL	1	0
2	A	903	GOL	2	0
2	A	902	GOL	2	0

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	803/815 (98%)	-0.27	8 (0%) 79 84	11, 25, 46, 69	4 (0%)

The worst 5 of 8 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	1	MET	3.8
1	A	803	ALA	3.1
1	A	124	ASP	2.7
1	A	781	GLY	2.5
1	A	411	PRO	2.4

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(Å ²)	Q<0.9
3	SO4	A	913	5/5	0.82	0.13	82,85,95,95	0
2	GOL	A	907	6/6	0.83	0.19	48,60,61,67	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
2	GOL	A	902	6/6	0.85	0.18	37,49,53,55	0
2	GOL	A	905	6/6	0.86	0.18	48,53,56,59	0
2	GOL	A	906	6/6	0.89	0.13	35,41,44,50	0
3	SO4	A	911	5/5	0.90	0.09	46,49,63,68	0
3	SO4	A	912	5/5	0.91	0.07	71,73,77,78	0
3	SO4	A	910	5/5	0.92	0.09	44,55,56,59	0
2	GOL	A	903	6/6	0.93	0.11	32,41,46,47	0
2	GOL	A	904	6/6	0.94	0.13	27,41,46,48	0
4	CL	A	914	1/1	0.94	0.18	44,44,44,44	0
3	SO4	A	908	5/5	0.96	0.10	33,37,40,49	0
2	GOL	A	901	6/6	0.97	0.07	24,26,28,33	0
3	SO4	A	909	5/5	0.98	0.10	30,36,38,51	0

6.5 Other polymers [i](#)

There are no such residues in this entry.