



wwPDB X-ray Structure Validation Summary Report ⓘ

Apr 25, 2026 – 03:55 AM EDT

PDB ID : 1YUP / pdb_00001yup
Title : Reindeer beta-lactoglobulin
Authors : Goldman, A.; Oksanen, E.
Deposited on : 2005-02-14
Resolution : 2.10 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
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

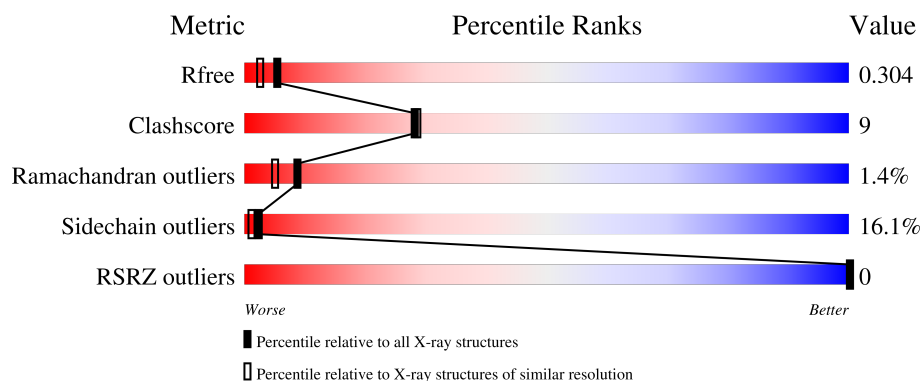
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

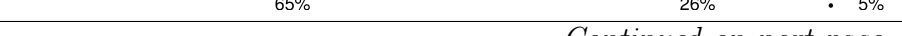
The reported resolution of this entry is 2.10 Å.

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}	180053	6658 (2.10-2.10)
Clashscore	190562	7164 (2.10-2.10)
Ramachandran outliers	187476	7099 (2.10-2.10)
Sidechain outliers	187428	7100 (2.10-2.10)
RSRZ outliers	180081	6662 (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 ≥ 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	162	
1	B	162	
1	C	162	
1	D	162	
1	E	162	

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Mol	Chain	Length	Quality of chain
1	F	162	 76% 18% • •
1	G	162	 66% 28% 5% •
1	H	162	 67% 22% • 6%

2 Entry composition [i](#)

There are 2 unique types of molecules in this entry. The entry contains 10045 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-lactoglobulin.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	162	Total	C	N	O	S	0	1	0
			1241	788	202	241	10			
1	B	158	Total	C	N	O	S	0	0	0
			1191	758	196	227	10			
1	C	160	Total	C	N	O	S	0	1	0
			1220	773	197	240	10			
1	D	158	Total	C	N	O	S	0	1	0
			1216	771	197	238	10			
1	E	154	Total	C	N	O	S	0	1	0
			1189	757	194	229	9			
1	F	159	Total	C	N	O	S	0	1	0
			1220	777	199	234	10			
1	G	160	Total	C	N	O	S	0	1	0
			1238	787	202	239	10			
1	H	152	Total	C	N	O	S	0	1	0
			1169	745	190	225	9			

- Molecule 2 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	A	68	Total	O	0	0
			68	68		
2	B	32	Total	O	0	0
			32	32		
2	C	49	Total	O	0	0
			49	49		
2	D	33	Total	O	0	0
			33	33		
2	E	45	Total	O	0	0
			45	45		
2	F	42	Total	O	0	0
			42	42		

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Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
2	G	52	Total	O	0	0
			52	52		
2	H	40	Total	O	0	0
			40	40		

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.

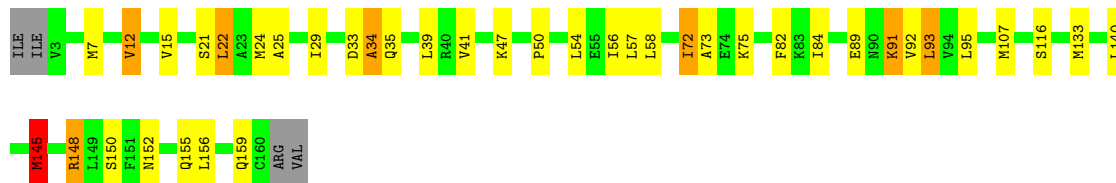
• Molecule 1: beta-lactoglobulin

Chain A: 



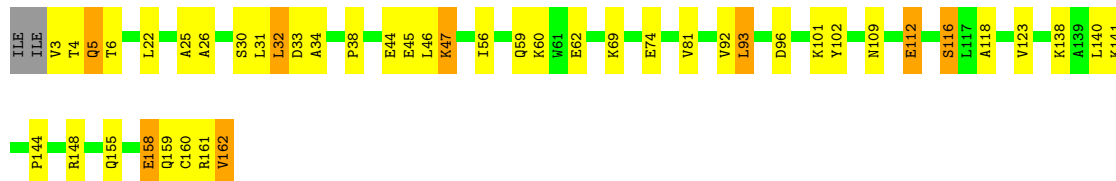
• Molecule 1: beta-lactoglobulin

Chain B: 



• Molecule 1: beta-lactoglobulin

Chain C: 



• Molecule 1: beta-lactoglobulin

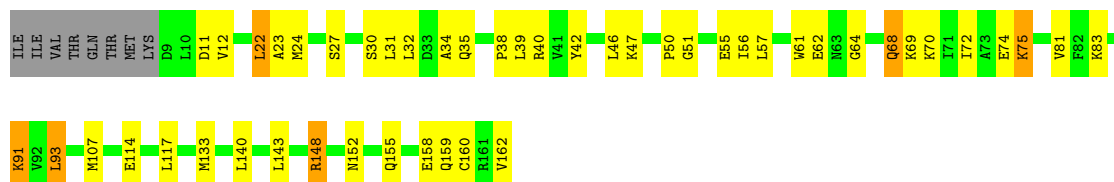
Chain D: 





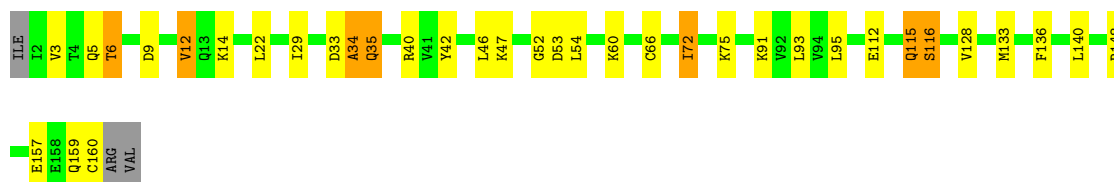
- Molecule 1: beta-lactoglobulin

Chain E: 65% 26% 5%



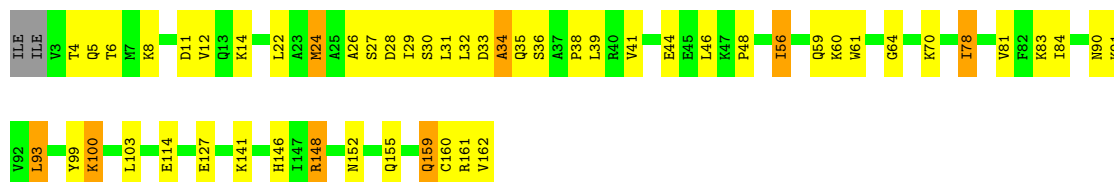
- Molecule 1: beta-lactoglobulin

Chain F: 76% 18% 2%



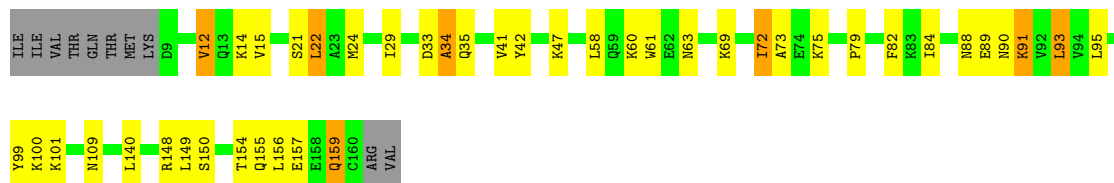
- Molecule 1: beta-lactoglobulin

Chain G: 66% 28% 5%



- Molecule 1: beta-lactoglobulin

Chain H: 67% 22% 6%



4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, α , β , γ	52.24Å 94.14Å 64.15Å 90.00° 105.76° 90.00°	Depositor
Resolution (Å)	19.96 – 2.10 19.96 – 2.10	Depositor EDS
% Data completeness (in resolution range)	100.0 (19.96-2.10) 93.1 (19.96-2.10)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.25 (at 2.09Å)	Xtriage
Refinement program	REFMAC 5.1.24	Depositor
R, R_{free}	0.235 , 0.311 0.236 , 0.304	Depositor DCC
R_{free} test set	3186 reflections (5.00%)	wwPDB-VP
Wilson B-factor (Å ²)	28.7	Xtriage
Anisotropy	0.355	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 24.0	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	0.477 for -h,k,-l	Xtriage
F_o, F_c correlation	0.97	EDS
Total number of atoms	10045	wwPDB-VP
Average B, all atoms (Å ²)	36.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 71.55 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 2.5742e-06. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

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](#)

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	0.84	0/1266	0.92	0/1717
1	B	0.83	2/1211 (0.2%)	0.94	0/1645
1	C	0.82	0/1245	0.98	0/1692
1	D	0.84	1/1239 (0.1%)	0.93	0/1677
1	E	0.86	0/1214	0.96	0/1648
1	F	0.81	1/1244 (0.1%)	0.91	1/1686 (0.1%)
1	G	0.87	1/1263 (0.1%)	0.95	1/1711 (0.1%)
1	H	0.79	0/1192	0.94	0/1613
All	All	0.83	5/9874 (0.1%)	0.94	2/13389 (0.0%)

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
1	C	0	1
1	E	0	1
1	G	0	1
All	All	0	4

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	145	MET	SD-CE	-7.63	1.60	1.79
1	G	56	ILE	CA-CB	6.36	1.62	1.54
1	D	128	VAL	CA-CB	6.32	1.60	1.53
1	F	128	VAL	CA-CB	5.30	1.60	1.53
1	B	24	MET	SD-CE	-5.01	1.67	1.79

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	F	72	ILE	N-CA-CB	6.46	117.76	110.72
1	G	56	ILE	CB-CA-C	5.01	118.04	110.63

There are no chirality outliers.

All (4) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	160[B]	CYS	Mainchain
1	C	160[B]	CYS	Mainchain
1	E	160[B]	CYS	Mainchain
1	G	160[B]	CYS	Mainchain

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	1241	0	1222	27	1
1	B	1191	0	1165	24	0
1	C	1220	0	1176	19	0
1	D	1216	0	1189	21	0
1	E	1189	0	1175	25	0
1	F	1220	0	1209	14	0
1	G	1238	0	1230	29	0
1	H	1169	0	1156	17	1
2	A	68	0	0	4	0
2	B	32	0	0	3	0
2	C	49	0	0	2	0
2	D	33	0	0	0	0
2	E	45	0	0	6	0
2	F	42	0	0	6	0
2	G	52	0	0	6	0
2	H	40	0	0	0	0
All	All	10045	0	9522	171	1

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 9.

The worst 5 of 171 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:E:31:LEU:O	1:E:38:PRO:O	1.95	0.84
1:C:31:LEU:O	1:C:38:PRO:O	1.98	0.80
1:G:152:ASN:H	1:G:155:GLN:HE21	1.31	0.77
1:E:35:GLN:CD	2:E:181:HOH:O	2.29	0.74
1:E:42:TYR:OH	2:E:181:HOH:O	2.08	0.72

All (1) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:11:ASP:OD2	1:H:91:LYS:NZ[1_545]	2.15	0.05

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	161/162 (99%)	145 (90%)	12 (8%)	4 (2%)	4	1
1	B	156/162 (96%)	143 (92%)	12 (8%)	1 (1%)	21	18
1	C	159/162 (98%)	145 (91%)	11 (7%)	3 (2%)	6	3
1	D	156/162 (96%)	139 (89%)	15 (10%)	2 (1%)	9	6
1	E	153/162 (94%)	141 (92%)	11 (7%)	1 (1%)	18	15
1	F	157/162 (97%)	146 (93%)	8 (5%)	3 (2%)	6	3
1	G	159/162 (98%)	147 (92%)	10 (6%)	2 (1%)	9	6
1	H	150/162 (93%)	133 (89%)	14 (9%)	3 (2%)	6	2
All	All	1251/1296 (96%)	1139 (91%)	93 (7%)	19 (2%)	9	4

5 of 19 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	34	ALA

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Mol	Chain	Res	Type
1	B	34	ALA
1	C	34	ALA
1	D	34	ALA
1	E	34	ALA

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	134/143 (94%)	114 (85%)	20 (15%)	3	1
1	B	125/143 (87%)	106 (85%)	19 (15%)	3	1
1	C	130/143 (91%)	110 (85%)	20 (15%)	2	1
1	D	131/143 (92%)	107 (82%)	24 (18%)	2	1
1	E	129/143 (90%)	108 (84%)	21 (16%)	2	1
1	F	132/143 (92%)	110 (83%)	22 (17%)	2	1
1	G	135/143 (94%)	113 (84%)	22 (16%)	2	1
1	H	126/143 (88%)	104 (82%)	22 (18%)	2	1
All	All	1042/1144 (91%)	872 (84%)	170 (16%)	2	1

5 of 170 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	F	72	ILE
1	G	100	LYS
1	F	95	LEU
1	G	24	MET
1	H	24	MET

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 20 such sidechains are listed below:

Mol	Chain	Res	Type
1	G	35	GLN

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Mol	Chain	Res	Type
1	H	35	GLN
1	H	159	GLN
1	H	152	ASN
1	D	35	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 [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	162/162 (100%)	-1.51	0 100 100	14, 35, 50, 55	1 (0%)
1	B	158/162 (97%)	-1.52	0 100 100	25, 35, 53, 56	0
1	C	160/162 (98%)	-1.47	0 100 100	21, 34, 53, 61	1 (0%)
1	D	158/162 (97%)	-1.51	0 100 100	24, 35, 51, 55	1 (0%)
1	E	154/162 (95%)	-1.54	0 100 100	18, 33, 48, 59	1 (0%)
1	F	159/162 (98%)	-1.51	0 100 100	24, 35, 51, 57	1 (0%)
1	G	160/162 (98%)	-1.53	0 100 100	17, 35, 49, 57	1 (0%)
1	H	152/162 (93%)	-1.51	0 100 100	24, 36, 52, 57	1 (0%)
All	All	1263/1296 (97%)	-1.51	0 100 100	14, 35, 52, 61	7 (0%)

There are no RSRZ outliers to report.

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.