



# wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 6, 2026 – 12:41 PM UTC

PDB ID : 5CDI / pdb\_00005cdi  
Title : Chloroplast chaperonin 60b1 of Chlamydomonas  
Authors : Zhang, S.; Zhou, H.; Yu, F.; Gao, F.; He, J.; Liu, C.  
Deposited on : 2015-07-04  
Resolution : 3.81 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)

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>.

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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  
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

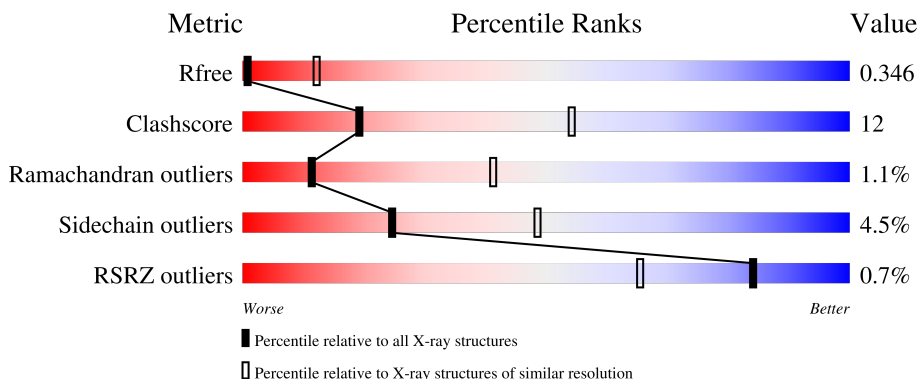
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

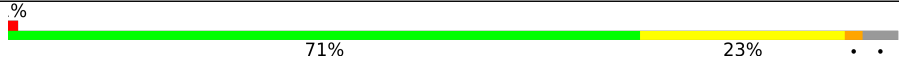
The reported resolution of this entry is 3.81 Å.

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	1065 (3.96-3.64)
Clashscore	190562	1012 (3.94-3.66)
Ramachandran outliers	187476	1048 (3.96-3.64)
Sidechain outliers	187428	1043 (3.96-3.64)
RSRZ outliers	180081	1064 (3.96-3.64)

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	552	
1	B	552	
1	C	552	
1	D	552	
1	E	552	

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Mol	Chain	Length	Quality of chain
1	F	552	 74% 21% ..
1	G	552	%  71% 23% ..
1	H	552	%  72% 22% ..
1	I	552	%  71% 23% ..
1	J	552	 71% 23% ..
1	K	552	%  74% 20% ..
1	L	552	 72% 22% ..
1	M	552	 72% 22% ..
1	N	552	%  75% 19% ..

## 2 Entry composition [i](#)

There is only 1 type of molecule in this entry. The entry contains 55706 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 Chaperonin 60B1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	528	3979	2471	696	788	24	0	0	0
1	N	528	3979	2471	696	788	24	0	0	0
1	B	528	3979	2471	696	788	24	0	0	0
1	C	528	3979	2471	696	788	24	0	0	0
1	D	528	3979	2471	696	788	24	0	0	0
1	E	528	3979	2471	696	788	24	0	0	0
1	F	528	3979	2471	696	788	24	0	0	0
1	G	528	3979	2471	696	788	24	0	0	0
1	H	528	3979	2471	696	788	24	0	0	0
1	I	528	3979	2471	696	788	24	0	0	0
1	J	528	3979	2471	696	788	24	0	0	0
1	K	528	3979	2471	696	788	24	0	0	0
1	L	528	3979	2471	696	788	24	0	0	0
1	M	528	3979	2471	696	788	24	0	0	0

There are 28 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1	MET	-	expression tag	UNP A8JE91

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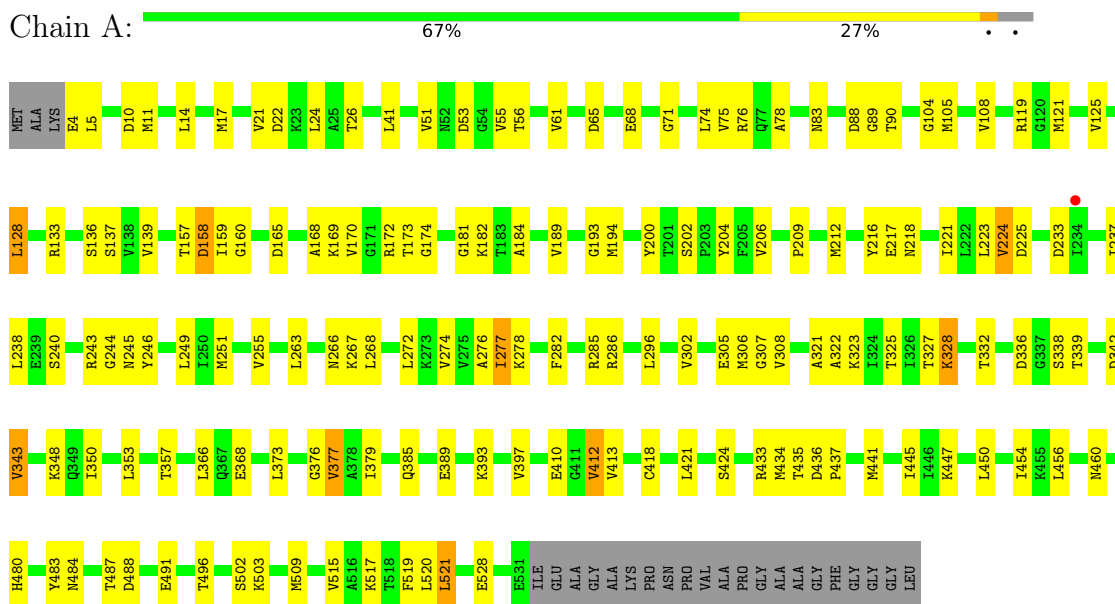
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Chain	Residue	Modelled	Actual	Comment	Reference
A	138	VAL	-	see sequence details	UNP A8JE91
N	1	MET	-	expression tag	UNP A8JE91
N	138	VAL	-	see sequence details	UNP A8JE91
B	1	MET	-	expression tag	UNP A8JE91
B	138	VAL	-	see sequence details	UNP A8JE91
C	1	MET	-	expression tag	UNP A8JE91
C	138	VAL	-	see sequence details	UNP A8JE91
D	1	MET	-	expression tag	UNP A8JE91
D	138	VAL	-	see sequence details	UNP A8JE91
E	1	MET	-	expression tag	UNP A8JE91
E	138	VAL	-	see sequence details	UNP A8JE91
F	1	MET	-	expression tag	UNP A8JE91
F	138	VAL	-	see sequence details	UNP A8JE91
G	1	MET	-	expression tag	UNP A8JE91
G	138	VAL	-	see sequence details	UNP A8JE91
H	1	MET	-	expression tag	UNP A8JE91
H	138	VAL	-	see sequence details	UNP A8JE91
I	1	MET	-	expression tag	UNP A8JE91
I	138	VAL	-	see sequence details	UNP A8JE91
J	1	MET	-	expression tag	UNP A8JE91
J	138	VAL	-	see sequence details	UNP A8JE91
K	1	MET	-	expression tag	UNP A8JE91
K	138	VAL	-	see sequence details	UNP A8JE91
L	1	MET	-	expression tag	UNP A8JE91
L	138	VAL	-	see sequence details	UNP A8JE91
M	1	MET	-	expression tag	UNP A8JE91
M	138	VAL	-	see sequence details	UNP A8JE91

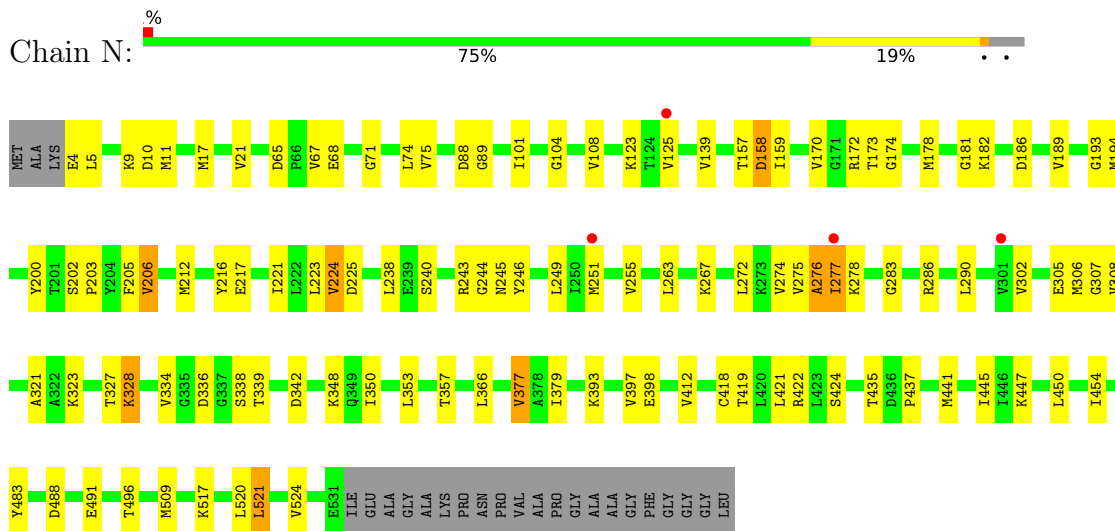
### 3 Residue-property plots [i](#)

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.

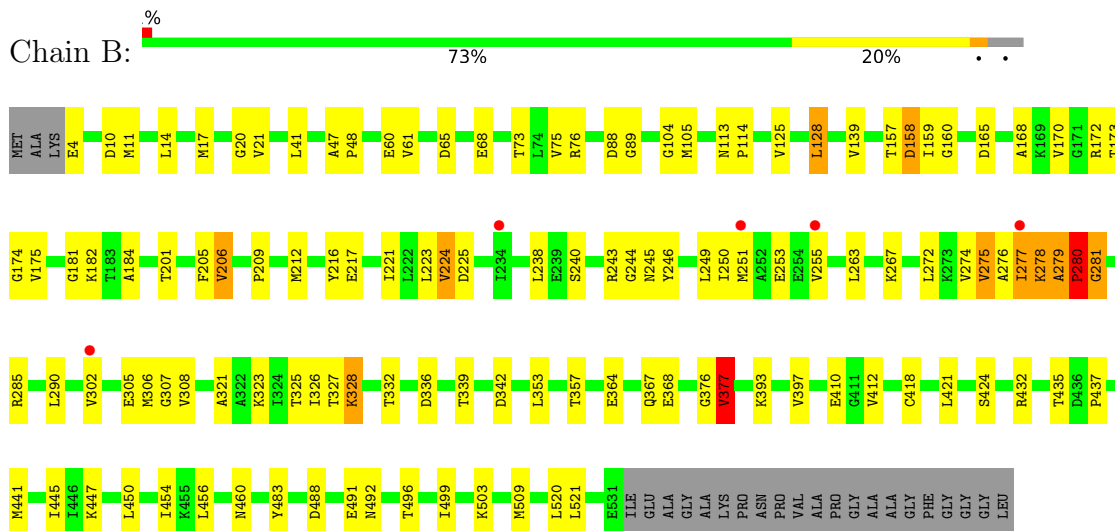
- Molecule 1: Chaperonin 60B1



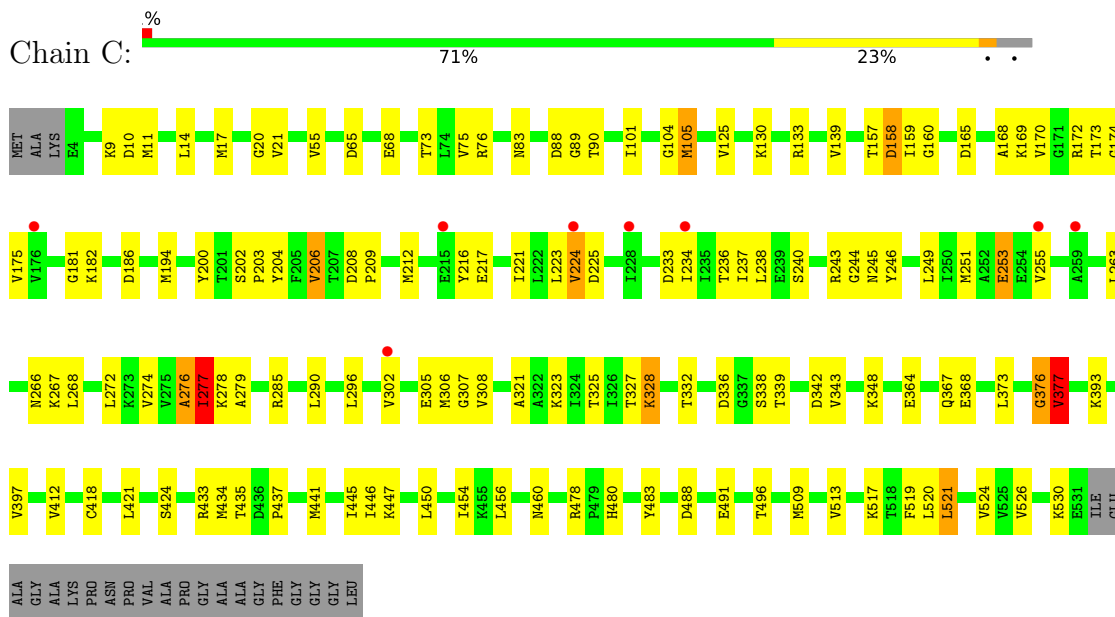
- Molecule 1: Chaperonin 60B1



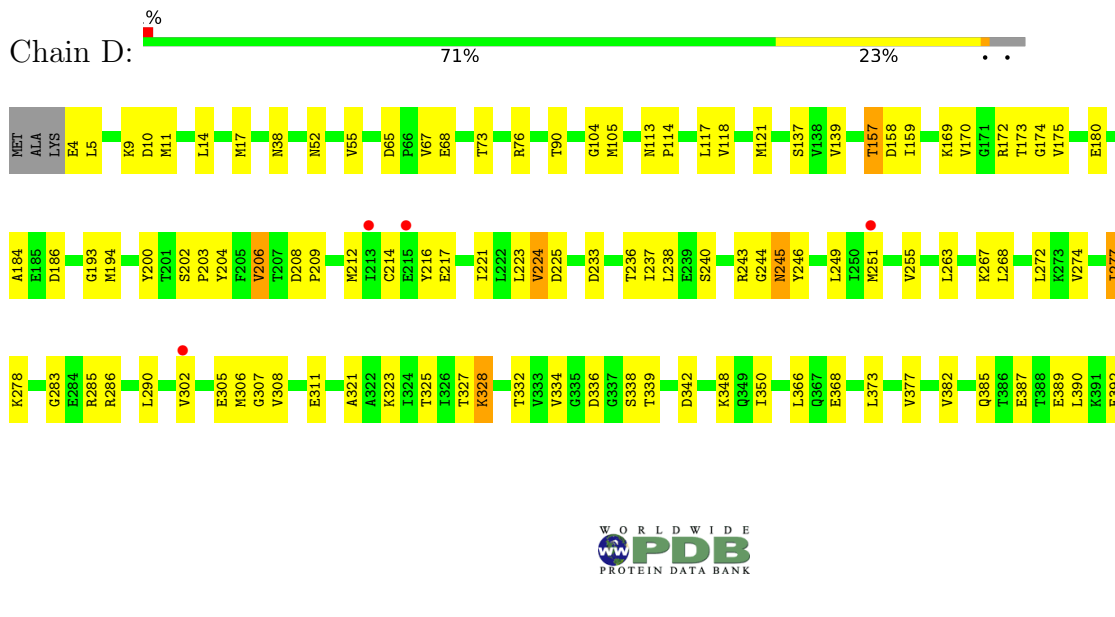
- Molecule 1: Chaperonin 60B1

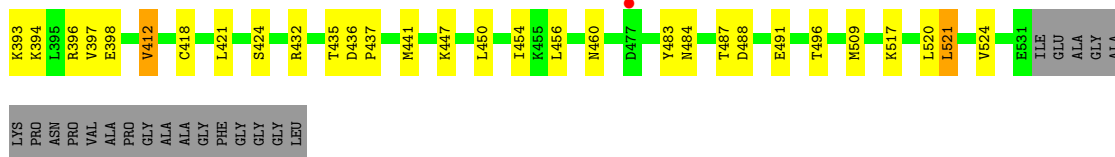


• Molecule 1: Chaperonin 60B1

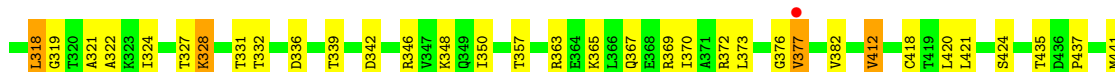
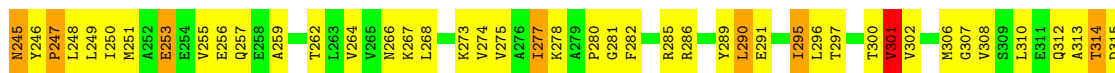


• Molecule 1: Chaperonin 60B1

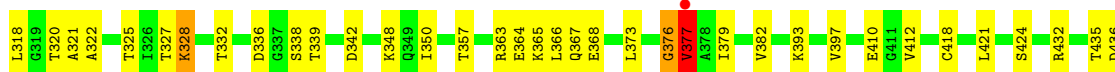




• Molecule 1: Chaperonin 60B1

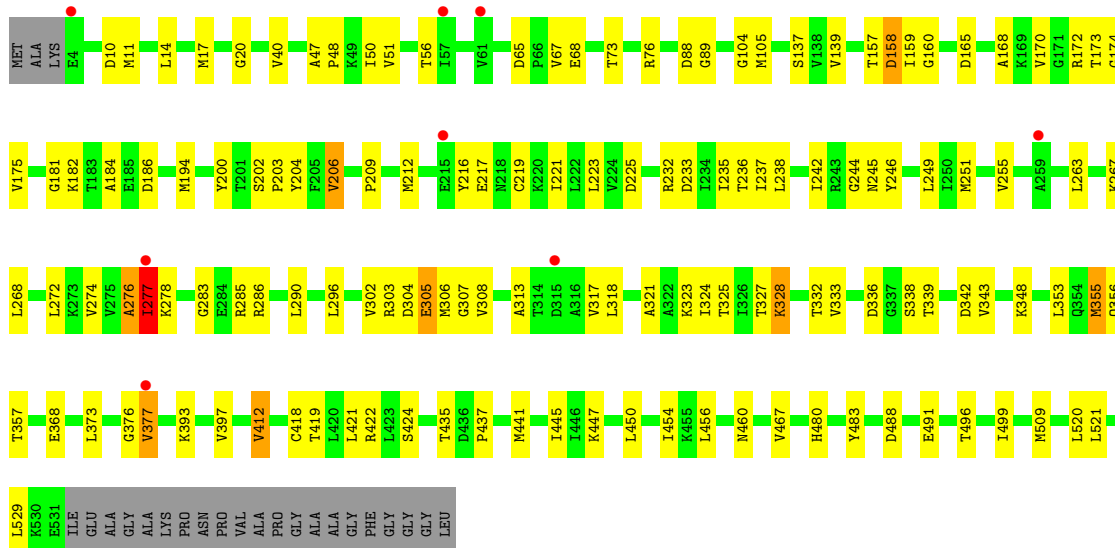


• Molecule 1: Chaperonin 60B1

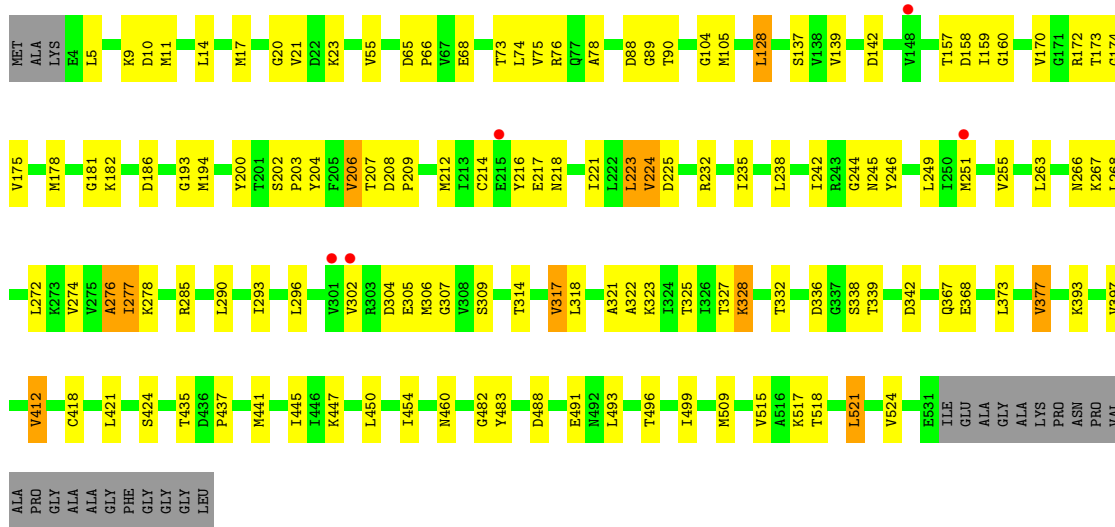


• Molecule 1: Chaperonin 60B1

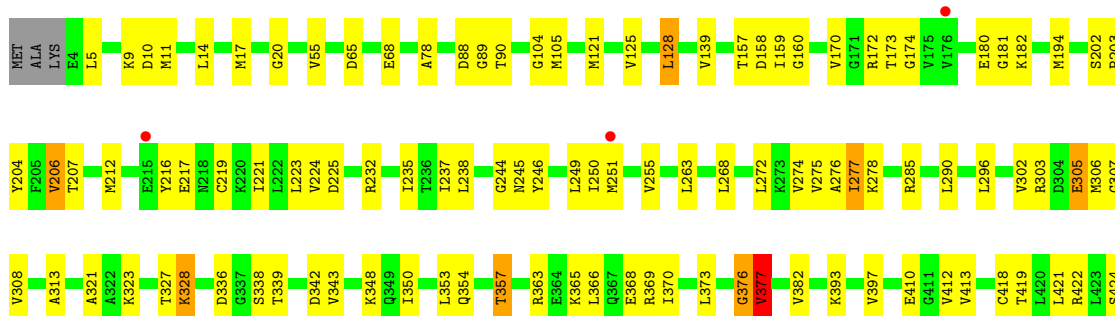




• Molecule 1: Chaperonin 60B1

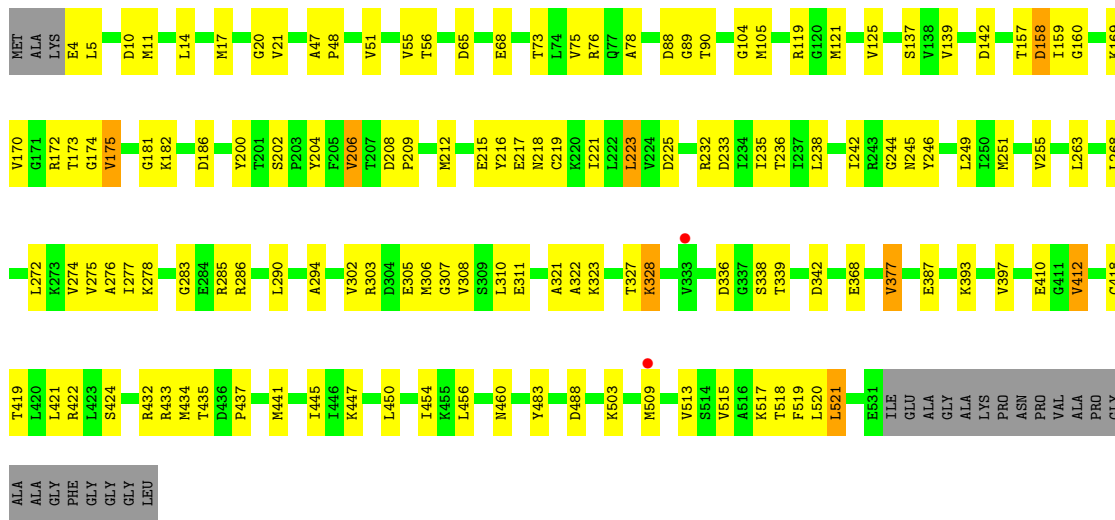


• Molecule 1: Chaperonin 60B1

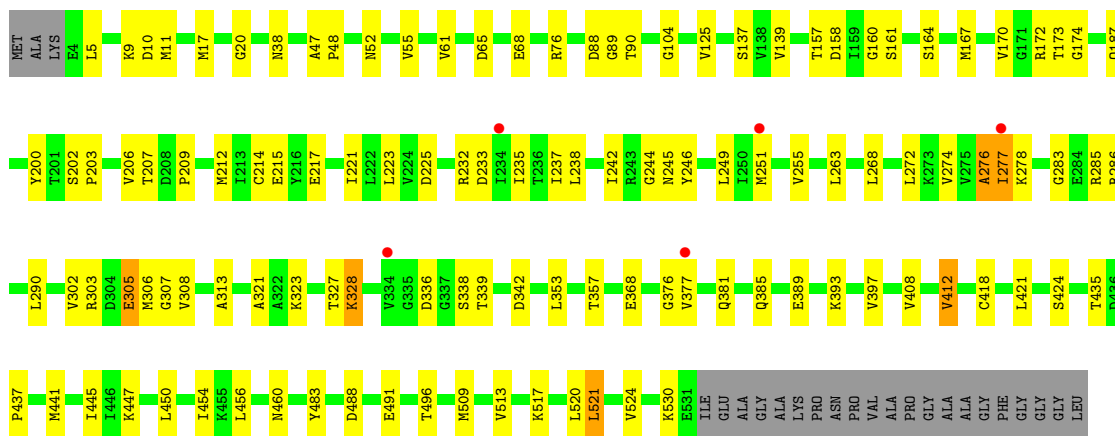
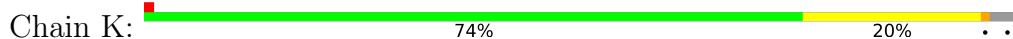




• Molecule 1: Chaperonin 60B1

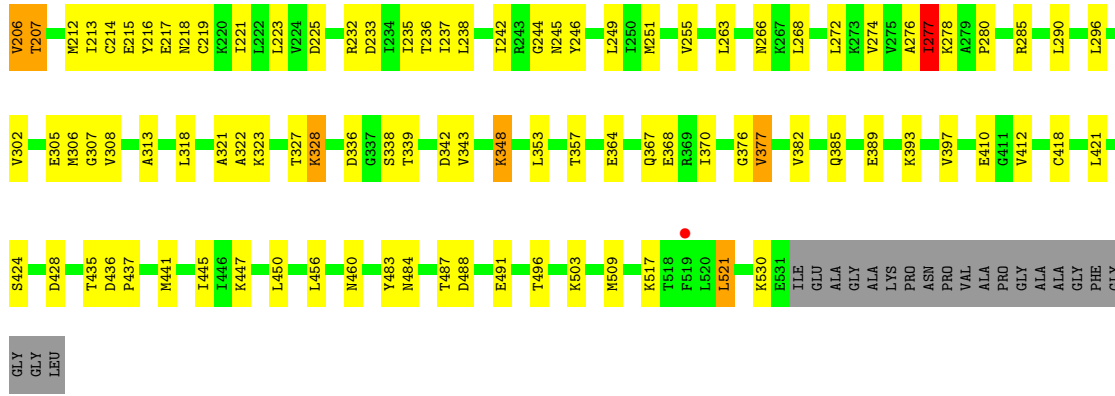


• Molecule 1: Chaperonin 60B1

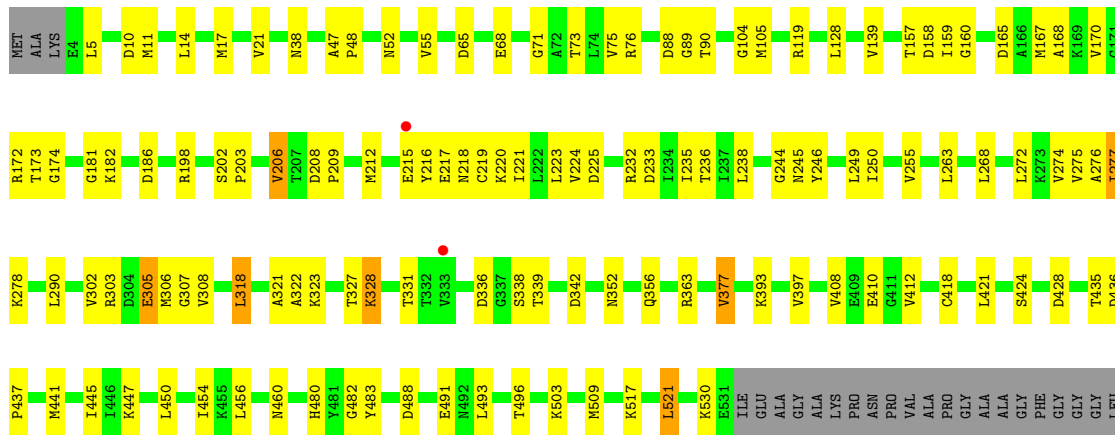


• Molecule 1: Chaperonin 60B1





• Molecule 1: Chaperonin 60B1



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	143.34Å 174.39Å 213.68Å 90.00° 94.69° 90.00°	Depositor
Resolution (Å)	48.66 – 3.81 48.66 – 3.81	Depositor EDS
% Data completeness (in resolution range)	96.7 (48.66-3.81) 85.0 (48.66-3.81)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.77 (at 3.77Å)	Xtrriage
Refinement program	PHENIX 1.9_1692	Depositor
R, $R_{free}$	0.275 , 0.325 0.298 , 0.346	Depositor DCC
$R_{free}$ test set	2003 reflections (2.01%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	129.8	Xtrriage
Anisotropy	0.235	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.31 , 155.7	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.31$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.90	EDS
Total number of atoms	55706	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	186.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.25% 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	0.30	0/4011	0.73	0/5417
1	B	0.37	4/4011 (0.1%)	0.78	3/5417 (0.1%)
1	C	0.37	4/4011 (0.1%)	0.77	4/5417 (0.1%)
1	D	0.34	2/4011 (0.0%)	0.74	0/5417
1	E	0.46	5/4011 (0.1%)	0.85	14/5417 (0.3%)
1	F	0.34	3/4011 (0.1%)	0.73	0/5417
1	G	0.37	3/4011 (0.1%)	0.74	0/5417
1	H	0.34	1/4011 (0.0%)	0.76	3/5417 (0.1%)
1	I	0.32	2/4011 (0.0%)	0.75	1/5417 (0.0%)
1	J	0.36	3/4011 (0.1%)	0.74	0/5417
1	K	0.31	1/4011 (0.0%)	0.76	4/5417 (0.1%)
1	L	0.32	0/4011	0.74	1/5417 (0.0%)
1	M	0.37	3/4011 (0.1%)	0.73	1/5417 (0.0%)
1	N	0.35	2/4011 (0.0%)	0.75	3/5417 (0.1%)
All	All	0.35	33/56154 (0.1%)	0.75	34/75838 (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	B	0	1
1	C	0	1
1	E	0	1
1	L	0	1
All	All	0	4

The worst 5 of 33 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	E	377	VAL	C-N	17.61	1.57	1.33
1	N	276	ALA	C-N	-9.51	1.20	1.33

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	G	206	VAL	C-N	-9.12	1.21	1.33
1	M	215	GLU	C-N	8.25	1.45	1.33
1	H	276	ALA	C-N	-8.14	1.22	1.33

The worst 5 of 34 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	277	ILE	N-CA-C	13.70	127.65	107.37
1	C	276	ALA	O-C-N	-9.68	110.61	123.10
1	H	276	ALA	O-C-N	-8.84	111.69	123.10
1	E	202	SER	C-N-CD	8.81	139.97	120.60
1	E	246	TYR	CA-C-N	8.76	130.79	119.84

There are no chirality outliers.

All (4) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	B	279	ALA	Peptide
1	C	277	ILE	Mainchain
1	E	202	SER	Peptide
1	L	277	ILE	Mainchain

## 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	3979	0	4104	98	0
1	B	3979	0	4104	97	0
1	C	3979	0	4104	91	0
1	D	3979	0	4104	95	0
1	E	3979	0	4104	219	0
1	F	3979	0	4104	92	0
1	G	3979	0	4104	87	0
1	H	3979	0	4104	82	0
1	I	3979	0	4104	80	0
1	J	3979	0	4104	86	0
1	K	3979	0	4104	75	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	L	3979	0	4104	77	0
1	M	3979	0	4104	74	0
1	N	3979	0	4104	81	0
All	All	55706	0	57456	1325	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 12.

The worst 5 of 1325 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:205:PHE:CE2	1:E:267:LYS:CB	1.85	1.55
1:E:205:PHE:CE2	1:E:267:LYS:HB3	0.97	1.47
1:E:59:ARG:HH22	1:E:212:MET:CE	1.27	1.46
1:E:251:MET:HA	1:E:277:ILE:CG2	1.46	1.46
1:E:277:ILE:HD12	1:E:278:LYS:N	1.27	1.43

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	526/552 (95%)	480 (91%)	40 (8%)	6 (1%)	11 41
1	B	526/552 (95%)	473 (90%)	46 (9%)	7 (1%)	9 38
1	C	526/552 (95%)	479 (91%)	40 (8%)	7 (1%)	9 38
1	D	526/552 (95%)	479 (91%)	42 (8%)	5 (1%)	12 43
1	E	526/552 (95%)	472 (90%)	40 (8%)	14 (3%)	4 27
1	F	526/552 (95%)	480 (91%)	42 (8%)	4 (1%)	16 48
1	G	526/552 (95%)	483 (92%)	37 (7%)	6 (1%)	11 41

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	H	526/552 (95%)	478 (91%)	43 (8%)	5 (1%)	12	43
1	I	526/552 (95%)	482 (92%)	39 (7%)	5 (1%)	12	43
1	J	526/552 (95%)	480 (91%)	42 (8%)	4 (1%)	16	48
1	K	526/552 (95%)	478 (91%)	43 (8%)	5 (1%)	12	43
1	L	526/552 (95%)	478 (91%)	43 (8%)	5 (1%)	12	43
1	M	526/552 (95%)	475 (90%)	47 (9%)	4 (1%)	16	48
1	N	526/552 (95%)	480 (91%)	42 (8%)	4 (1%)	16	48
All	All	7364/7728 (95%)	6697 (91%)	586 (8%)	81 (1%)	11	41

5 of 81 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	158	ASP
1	A	173	THR
1	A	245	ASN
1	N	158	ASP
1	N	173	THR

### 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	433/445 (97%)	415 (96%)	18 (4%)	26	50
1	B	433/445 (97%)	415 (96%)	18 (4%)	26	50
1	C	433/445 (97%)	417 (96%)	16 (4%)	30	54
1	D	433/445 (97%)	415 (96%)	18 (4%)	26	50
1	E	433/445 (97%)	404 (93%)	29 (7%)	15	41
1	F	433/445 (97%)	415 (96%)	18 (4%)	26	50
1	G	433/445 (97%)	412 (95%)	21 (5%)	23	47
1	H	433/445 (97%)	409 (94%)	24 (6%)	19	45
1	I	433/445 (97%)	413 (95%)	20 (5%)	24	48

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	J	433/445 (97%)	417 (96%)	16 (4%)	30	54
1	K	433/445 (97%)	417 (96%)	16 (4%)	30	54
1	L	433/445 (97%)	413 (95%)	20 (5%)	24	48
1	M	433/445 (97%)	414 (96%)	19 (4%)	25	49
1	N	433/445 (97%)	416 (96%)	17 (4%)	28	52
All	All	6062/6230 (97%)	5792 (96%)	270 (4%)	24	48

5 of 270 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	L	5	LEU
1	L	255	VAL
1	M	302	VAL
1	E	211	ARG
1	E	205	PHE

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 30 such sidechains are listed below:

Mol	Chain	Res	Type
1	D	69	ASN
1	K	69	ASN
1	E	367	GLN
1	M	83	ASN
1	I	69	ASN

### 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, 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	528/552 (95%)	-0.37	1 (0%) 91 81	64, 175, 274, 319	0
1	B	528/552 (95%)	-0.24	5 (0%) 81 60	49, 165, 283, 325	0
1	C	528/552 (95%)	-0.30	8 (1%) 72 50	50, 166, 284, 318	0
1	D	528/552 (95%)	-0.18	5 (0%) 81 60	55, 153, 262, 292	0
1	E	528/552 (95%)	-0.21	3 (0%) 85 68	26, 159, 234, 301	0
1	F	528/552 (95%)	-0.29	2 (0%) 88 74	69, 184, 271, 303	0
1	G	528/552 (95%)	-0.18	8 (1%) 72 50	55, 193, 280, 315	0
1	H	528/552 (95%)	-0.28	5 (0%) 81 60	57, 182, 288, 319	0
1	I	528/552 (95%)	-0.30	3 (0%) 85 68	57, 192, 299, 325	0
1	J	528/552 (95%)	-0.31	2 (0%) 88 74	84, 203, 315, 369	0
1	K	528/552 (95%)	-0.28	5 (0%) 81 60	71, 189, 307, 340	0
1	L	528/552 (95%)	-0.30	1 (0%) 91 81	70, 185, 310, 357	0
1	M	528/552 (95%)	-0.36	2 (0%) 88 74	81, 207, 326, 366	0
1	N	528/552 (95%)	-0.32	4 (0%) 82 62	77, 194, 294, 335	0
All	All	7392/7728 (95%)	-0.28	54 (0%) 84 65	26, 178, 296, 369	0

The worst 5 of 54 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	277	ILE	5.2
1	D	302	VAL	4.7
1	I	251	MET	4.2
1	B	302	VAL	3.9
1	H	251	MET	3.6

## 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](#)

There are no ligands in this entry.

## 6.5 Other polymers [i](#)

There are no such residues in this entry.