



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 29, 2026 – 03:17 AM UTC

PDB ID : 4WGL / pdb_00004wgl
Title : Crystal structure of a GroEL D83A/R197A double mutant
Authors : Yang, D.; Fei, X.; LaRonde, N.A.; Beckett, D.; Lund, P.A.; Lorimer, G.H.
Deposited on : 2014-09-19
Resolution : 3.13 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

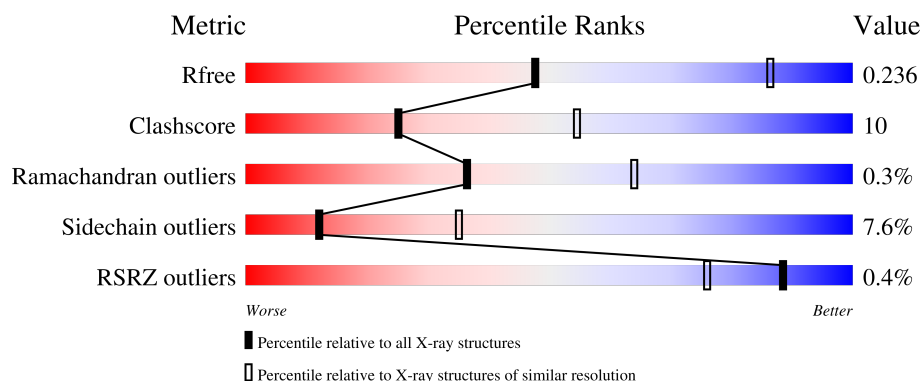
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.13 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	2351 (3.18-3.10)
Clashscore	190562	2452 (3.18-3.10)
Ramachandran outliers	187476	2324 (3.18-3.10)
Sidechain outliers	187428	2324 (3.18-3.10)
RSRZ outliers	180081	2351 (3.18-3.10)

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	548	73% 19% . .
1	B	548	68% 26% . .
1	C	548	72% 21% . .
1	D	548	69% 24% . .
1	E	548	72% 20% . .

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Mol	Chain	Length	Quality of chain
1	F	548	 66%27%. .
1	G	548	 70%23%. .
1	H	548	 71%22%. .
1	I	548	 69%23%. .
1	J	548	 68%24%. .
1	K	548	 68%24%. .
1	L	548	 71%22%. .
1	M	548	 71%23%. .
1	N	548	 74%19%. .

2 Entry composition

There is only 1 type of molecule in this entry. The entry contains 53844 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 60 kDa chaperonin.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	524	Total	C	N	O	S	0	0	0
			3846	2393	662	771	20			
1	B	524	Total	C	N	O	S	0	0	0
			3846	2393	662	771	20			
1	C	524	Total	C	N	O	S	0	0	0
			3846	2393	662	771	20			
1	D	524	Total	C	N	O	S	0	0	0
			3846	2393	662	771	20			
1	E	524	Total	C	N	O	S	0	0	0
			3846	2393	662	771	20			
1	F	524	Total	C	N	O	S	0	0	0
			3846	2393	662	771	20			
1	G	524	Total	C	N	O	S	0	0	0
			3846	2393	662	771	20			
1	H	524	Total	C	N	O	S	0	0	0
			3846	2393	662	771	20			
1	I	524	Total	C	N	O	S	0	0	0
			3846	2393	662	771	20			
1	J	524	Total	C	N	O	S	0	0	0
			3846	2393	662	771	20			
1	K	524	Total	C	N	O	S	0	0	0
			3846	2393	662	771	20			
1	L	524	Total	C	N	O	S	0	0	0
			3846	2393	662	771	20			
1	M	524	Total	C	N	O	S	0	0	0
			3846	2393	662	771	20			
1	N	524	Total	C	N	O	S	0	0	0
			3846	2393	662	771	20			

There are 28 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	83	ALA	ASP	engineered mutation	UNP P0A6F5

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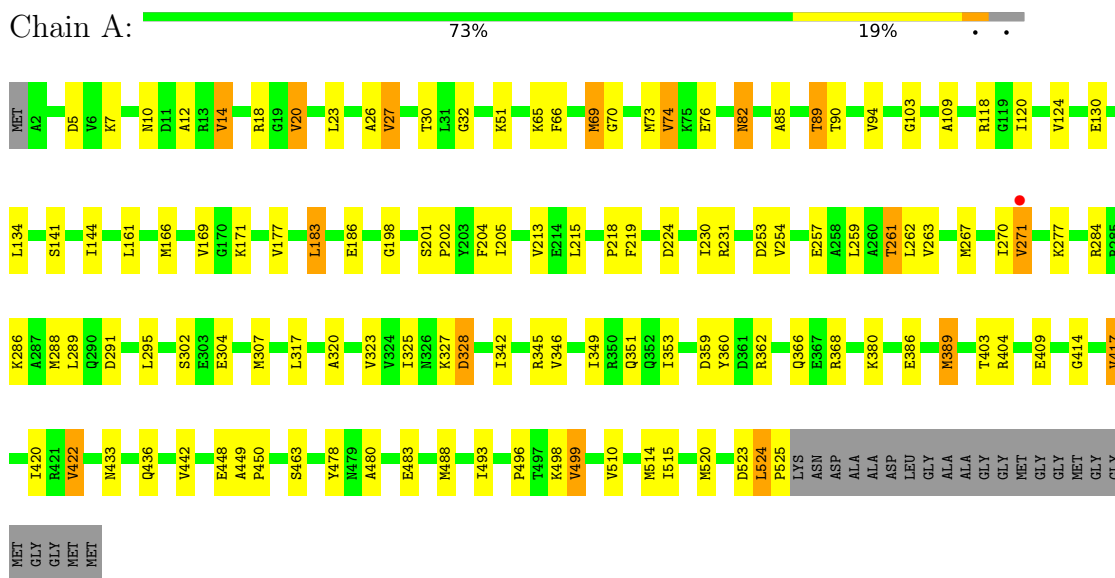
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Chain	Residue	Modelled	Actual	Comment	Reference
A	197	ALA	ARG	engineered mutation	UNP P0A6F5
B	83	ALA	ASP	engineered mutation	UNP P0A6F5
B	197	ALA	ARG	engineered mutation	UNP P0A6F5
C	83	ALA	ASP	engineered mutation	UNP P0A6F5
C	197	ALA	ARG	engineered mutation	UNP P0A6F5
D	83	ALA	ASP	engineered mutation	UNP P0A6F5
D	197	ALA	ARG	engineered mutation	UNP P0A6F5
E	83	ALA	ASP	engineered mutation	UNP P0A6F5
E	197	ALA	ARG	engineered mutation	UNP P0A6F5
F	83	ALA	ASP	engineered mutation	UNP P0A6F5
F	197	ALA	ARG	engineered mutation	UNP P0A6F5
G	83	ALA	ASP	engineered mutation	UNP P0A6F5
G	197	ALA	ARG	engineered mutation	UNP P0A6F5
H	83	ALA	ASP	engineered mutation	UNP P0A6F5
H	197	ALA	ARG	engineered mutation	UNP P0A6F5
I	83	ALA	ASP	engineered mutation	UNP P0A6F5
I	197	ALA	ARG	engineered mutation	UNP P0A6F5
J	83	ALA	ASP	engineered mutation	UNP P0A6F5
J	197	ALA	ARG	engineered mutation	UNP P0A6F5
K	83	ALA	ASP	engineered mutation	UNP P0A6F5
K	197	ALA	ARG	engineered mutation	UNP P0A6F5
L	83	ALA	ASP	engineered mutation	UNP P0A6F5
L	197	ALA	ARG	engineered mutation	UNP P0A6F5
M	83	ALA	ASP	engineered mutation	UNP P0A6F5
M	197	ALA	ARG	engineered mutation	UNP P0A6F5
N	83	ALA	ASP	engineered mutation	UNP P0A6F5
N	197	ALA	ARG	engineered mutation	UNP P0A6F5

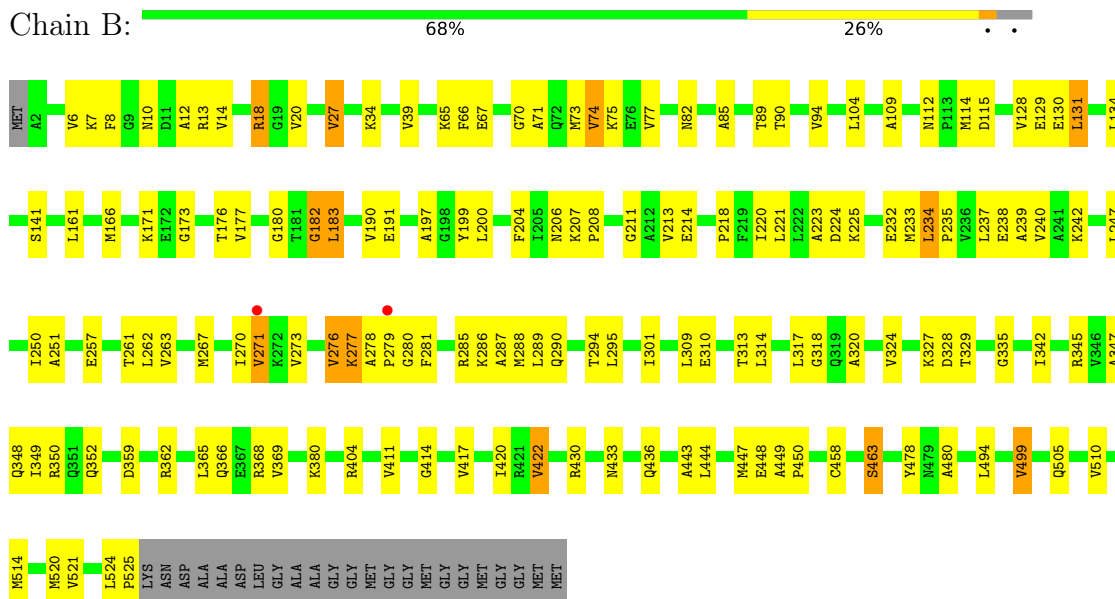
3 Residue-property plots

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: 60 kDa chaperonin

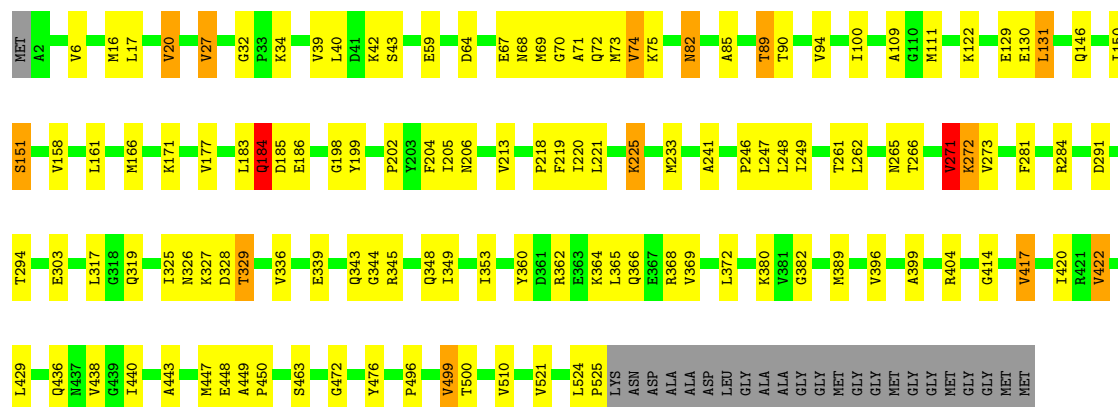


• Molecule 1: 60 kDa chaperonin



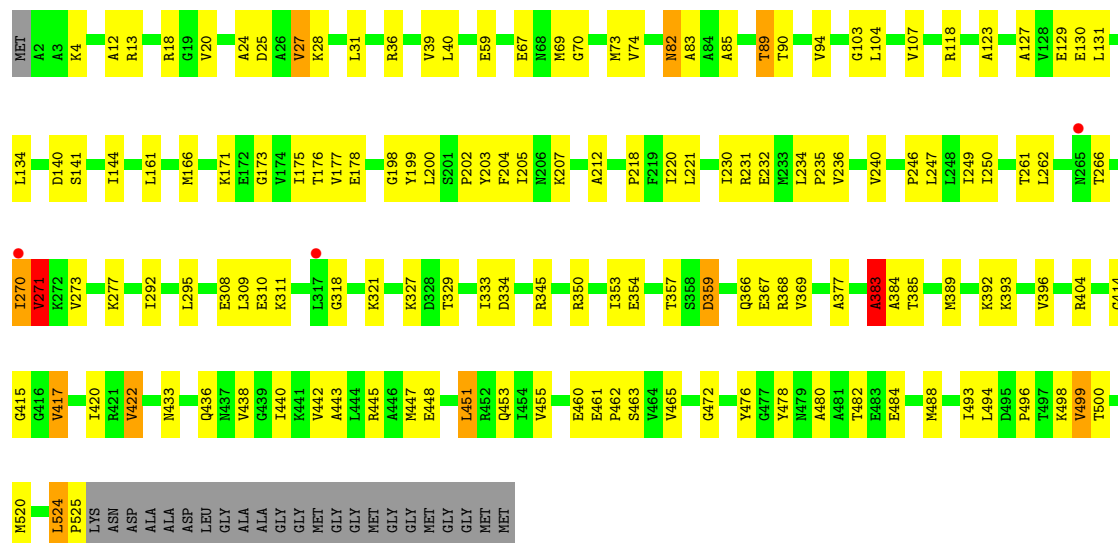
• Molecule 1: 60 kDa chaperonin

Chain C:  72% 21% . .



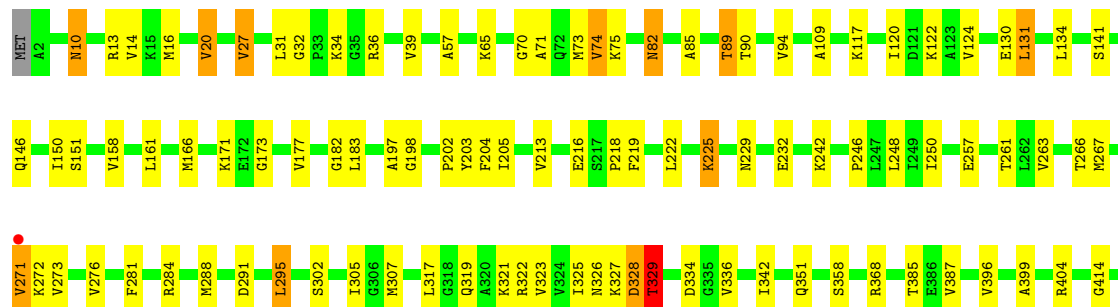
• Molecule 1: 60 kDa chaperonin

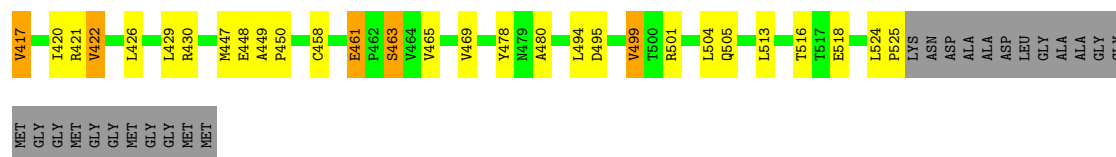
Chain D:  69% 24% . .



• Molecule 1: 60 kDa chaperonin

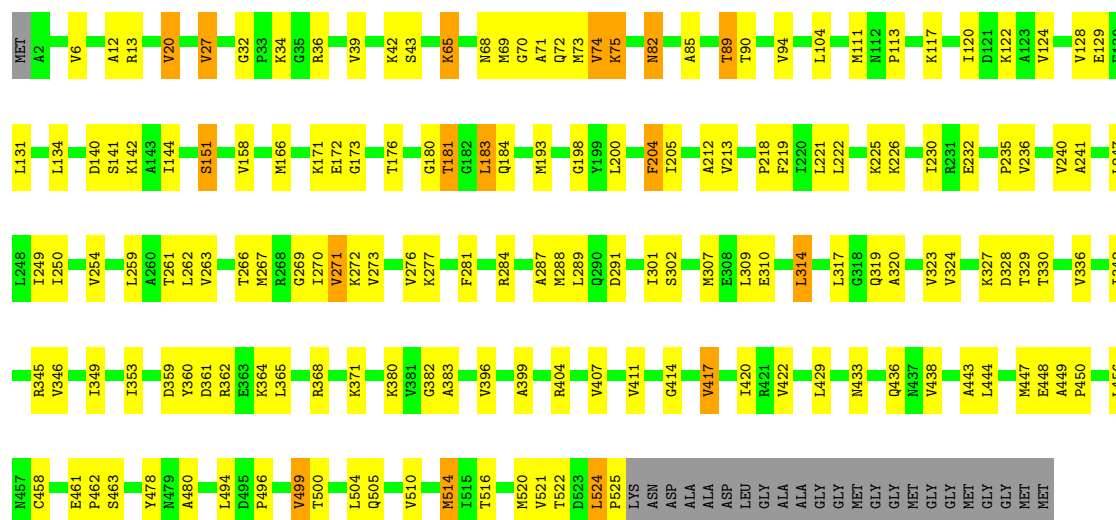
Chain E:  72% 20% . .





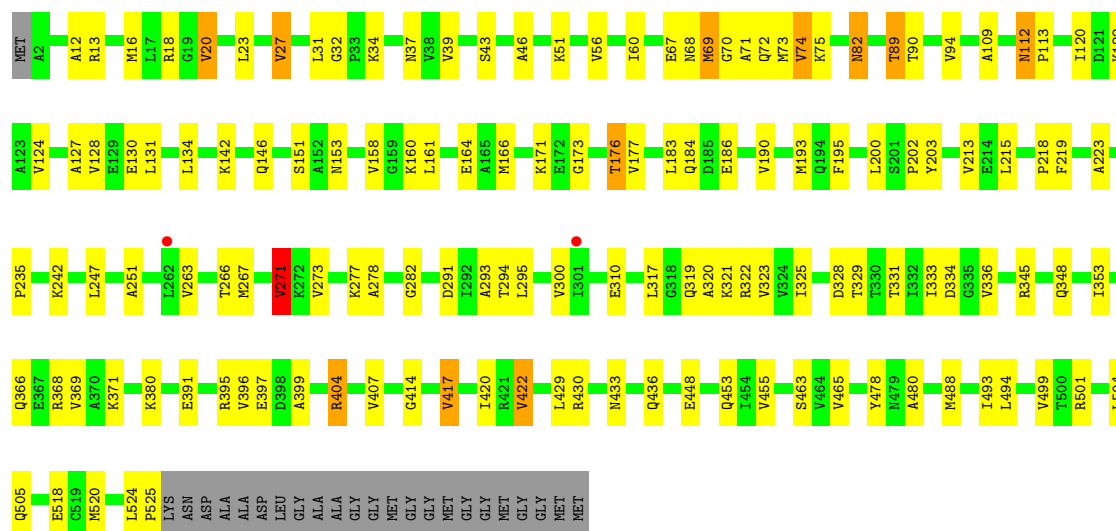
• Molecule 1: 60 kDa chaperonin

Chain F: 66% 27%



• Molecule 1: 60 kDa chaperonin

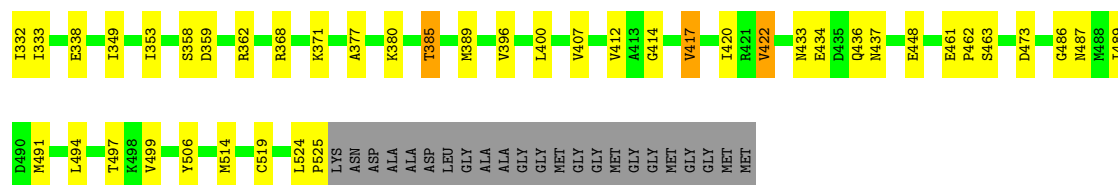
Chain G: 70% 23%



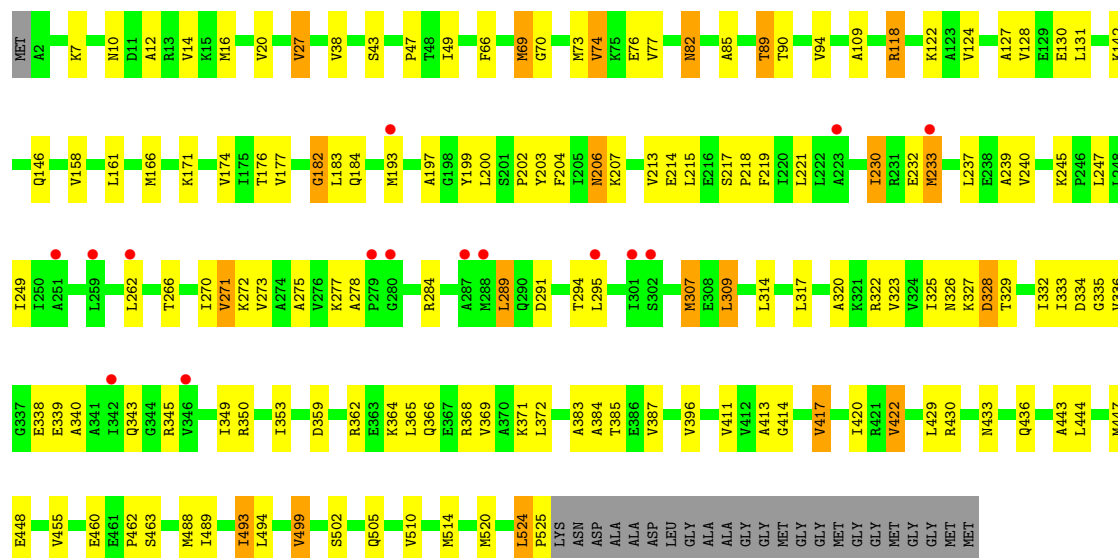
• Molecule 1: 60 kDa chaperonin

Chain H: 71% 22%

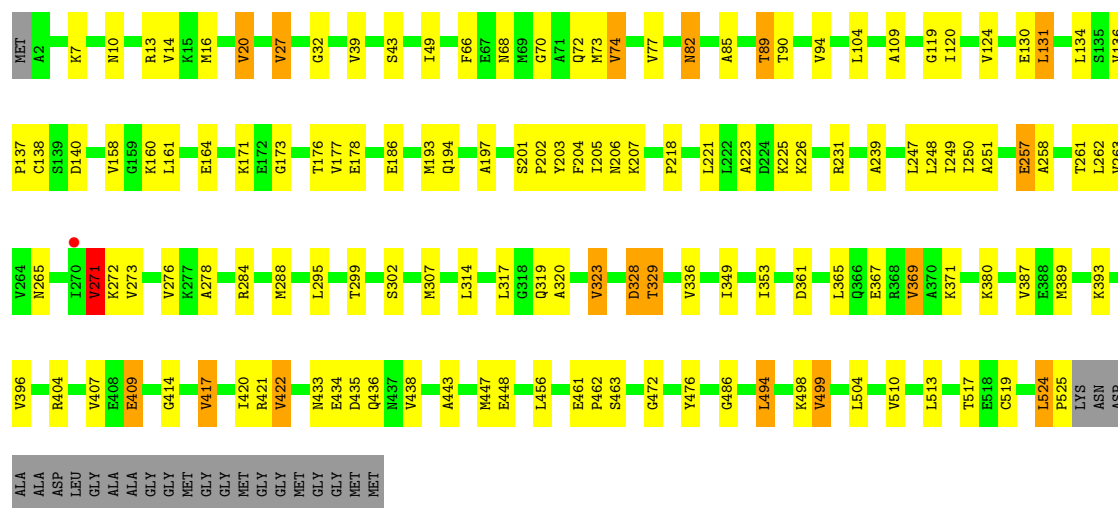




- Molecule 1: 60 kDa chaperonin

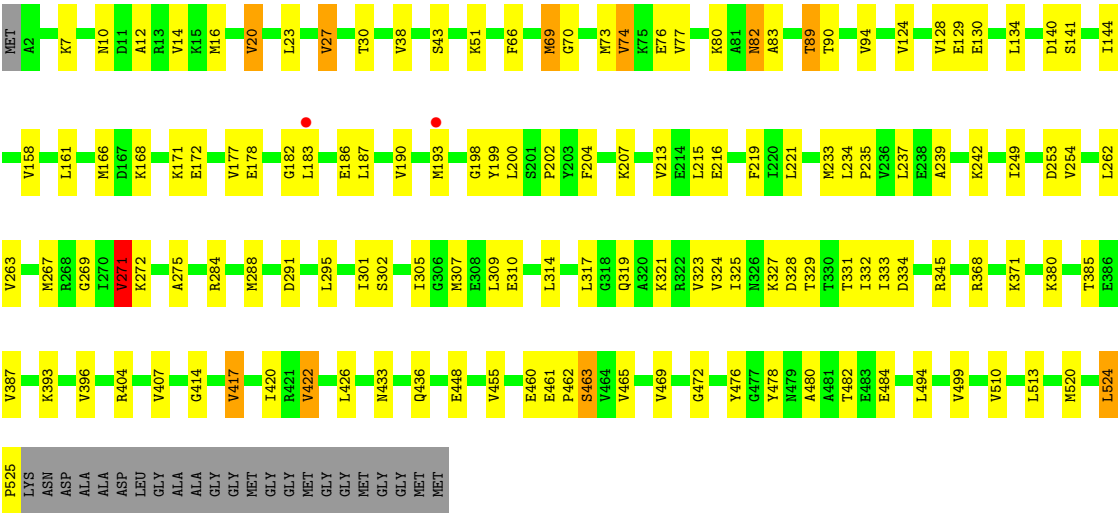


- Molecule 1: 60 kDa chaperonin

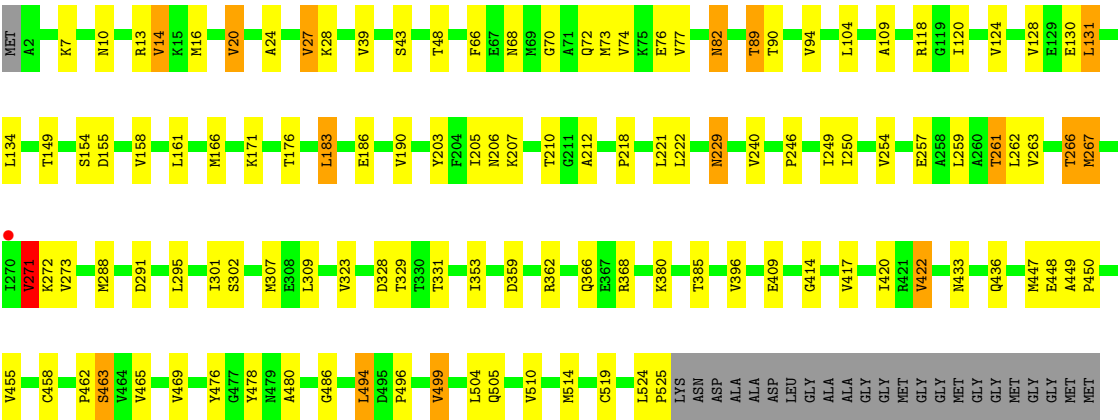


- Molecule 1: 60 kDa chaperonin





• Molecule 1: 60 kDa chaperonin



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	135.62Å 259.71Å 280.85Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	123.52 – 3.13 123.52 – 3.13	Depositor EDS
% Data completeness (in resolution range)	99.6 (123.52-3.13) 99.6 (123.52-3.13)	Depositor EDS
R_{merge}	0.14	Depositor
R_{sym}	0.15	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.65 (at 3.13Å)	Xtriage
Refinement program	PHENIX (phenix.refine: 1.8.4_1496)	Depositor
R, R_{free}	0.166 , 0.233 0.174 , 0.236	Depositor DCC
R_{free} test set	2003 reflections (1.15%)	wwPDB-VP
Wilson B-factor (Å ²)	69.5	Xtriage
Anisotropy	0.402	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.31 , 73.3	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	53844	wwPDB-VP
Average B, all atoms (Å ²)	80.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.62% 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

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	0.59	0/3874	0.94	4/5232 (0.1%)
1	B	0.58	0/3874	0.96	6/5232 (0.1%)
1	C	0.57	0/3874	0.89	2/5232 (0.0%)
1	D	0.59	1/3874 (0.0%)	0.92	4/5232 (0.1%)
1	E	0.57	0/3874	0.93	7/5232 (0.1%)
1	F	0.55	0/3874	0.94	5/5232 (0.1%)
1	G	0.56	0/3874	0.91	6/5232 (0.1%)
1	H	0.61	0/3874	0.95	5/5232 (0.1%)
1	I	0.63	0/3874	0.97	3/5232 (0.1%)
1	J	0.62	0/3874	0.96	6/5232 (0.1%)
1	K	0.58	0/3874	0.93	4/5232 (0.1%)
1	L	0.63	0/3874	0.97	7/5232 (0.1%)
1	M	0.55	0/3874	0.91	3/5232 (0.1%)
1	N	0.59	0/3874	0.94	4/5232 (0.1%)
All	All	0.59	1/54236 (0.0%)	0.94	66/73248 (0.1%)

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	D	0	1
1	J	0	1
All	All	0	2

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	D	383	ALA	CA-CB	-6.00	1.45	1.54

The worst 5 of 66 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	K	182	GLY	N-CA-C	10.85	125.94	111.72
1	G	32	GLY	CA-C-N	8.47	128.17	119.19
1	G	32	GLY	C-N-CA	8.47	128.17	119.19
1	D	383	ALA	N-CA-C	7.67	124.78	114.12
1	B	204	PHE	N-CA-C	-7.51	103.70	113.17

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	D	383	ALA	Peptide
1	J	31	LEU	Peptide

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	3846	0	3969	64	0
1	B	3846	0	3969	90	0
1	C	3846	0	3969	82	0
1	D	3846	0	3969	83	0
1	E	3846	0	3969	70	0
1	F	3846	0	3969	92	0
1	G	3846	0	3969	79	0
1	H	3846	0	3969	77	0
1	I	3846	0	3969	90	0
1	J	3846	0	3969	83	0
1	K	3846	0	3969	95	0
1	L	3846	0	3969	76	0
1	M	3846	0	3969	74	0
1	N	3846	0	3969	60	0
All	All	53844	0	55566	1059	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 10.

The worst 5 of 1059 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:K:232:GLU:HB3	1:K:309:LEU:HD11	1.46	0.95
1:F:241:ALA:HA	1:F:271:VAL:HG11	1.51	0.92
1:L:130:GLU:HB3	1:L:422:VAL:HG22	1.51	0.91
1:E:173:GLY:O	1:E:404:ARG:NH2	2.08	0.86
1:E:524:LEU:HD12	1:E:525:PRO:HD2	1.56	0.85

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	522/548 (95%)	512 (98%)	8 (2%)	2 (0%)	30	59
1	B	522/548 (95%)	510 (98%)	10 (2%)	2 (0%)	30	59
1	C	522/548 (95%)	510 (98%)	10 (2%)	2 (0%)	30	59
1	D	522/548 (95%)	511 (98%)	10 (2%)	1 (0%)	43	70
1	E	522/548 (95%)	510 (98%)	10 (2%)	2 (0%)	30	59
1	F	522/548 (95%)	511 (98%)	10 (2%)	1 (0%)	43	70
1	G	522/548 (95%)	512 (98%)	9 (2%)	1 (0%)	43	70
1	H	522/548 (95%)	514 (98%)	8 (2%)	0	100	100
1	I	522/548 (95%)	507 (97%)	13 (2%)	2 (0%)	30	59
1	J	522/548 (95%)	514 (98%)	7 (1%)	1 (0%)	43	70
1	K	522/548 (95%)	506 (97%)	14 (3%)	2 (0%)	30	59
1	L	522/548 (95%)	511 (98%)	10 (2%)	1 (0%)	43	70
1	M	522/548 (95%)	507 (97%)	14 (3%)	1 (0%)	43	70
1	N	522/548 (95%)	513 (98%)	8 (2%)	1 (0%)	43	70
All	All	7308/7672 (95%)	7148 (98%)	141 (2%)	19 (0%)	36	64

5 of 19 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	E	271	VAL
1	J	271	VAL
1	M	271	VAL
1	N	271	VAL
1	A	183	LEU

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	402/413 (97%)	371 (92%)	31 (8%)	12	34
1	B	402/413 (97%)	374 (93%)	28 (7%)	14	37
1	C	402/413 (97%)	378 (94%)	24 (6%)	17	43
1	D	402/413 (97%)	372 (92%)	30 (8%)	12	36
1	E	402/413 (97%)	372 (92%)	30 (8%)	12	36
1	F	402/413 (97%)	373 (93%)	29 (7%)	13	37
1	G	402/413 (97%)	379 (94%)	23 (6%)	18	45
1	H	402/413 (97%)	372 (92%)	30 (8%)	12	36
1	I	402/413 (97%)	368 (92%)	34 (8%)	10	31
1	J	402/413 (97%)	367 (91%)	35 (9%)	9	30
1	K	402/413 (97%)	369 (92%)	33 (8%)	10	32
1	L	402/413 (97%)	369 (92%)	33 (8%)	10	32
1	M	402/413 (97%)	370 (92%)	32 (8%)	11	33
1	N	402/413 (97%)	367 (91%)	35 (9%)	9	30
All	All	5628/5782 (97%)	5201 (92%)	427 (8%)	12	35

5 of 427 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	I	89	THR
1	J	358	SER
1	N	82	ASN

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Mol	Chain	Res	Type
1	I	172	GLU
1	J	20	VAL

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 39 such sidechains are listed below:

Mol	Chain	Res	Type
1	K	475	ASN
1	N	229	ASN
1	L	97	GLN
1	M	352	GLN
1	N	352	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

6.1 Protein, DNA and RNA chains

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	524/548 (95%)	-0.65	1 (0%) 91 83	22, 60, 120, 174	0
1	B	524/548 (95%)	-0.45	2 (0%) 88 76	24, 65, 207, 301	0
1	C	524/548 (95%)	-0.51	0 100 100	25, 70, 166, 204	0
1	D	524/548 (95%)	-0.47	3 (0%) 85 70	28, 73, 161, 232	0
1	E	524/548 (95%)	-0.59	1 (0%) 91 83	28, 69, 136, 190	0
1	F	524/548 (95%)	-0.57	0 100 100	31, 77, 135, 190	0
1	G	524/548 (95%)	-0.49	2 (0%) 88 76	27, 80, 167, 208	0
1	H	524/548 (95%)	-0.64	0 100 100	25, 63, 118, 168	0
1	I	524/548 (95%)	-0.62	3 (0%) 85 70	21, 54, 146, 227	0
1	J	524/548 (95%)	-0.63	1 (0%) 91 83	18, 63, 134, 189	0
1	K	524/548 (95%)	-0.25	15 (2%) 53 32	22, 66, 239, 292	0
1	L	524/548 (95%)	-0.65	1 (0%) 91 83	25, 58, 125, 177	0
1	M	524/548 (95%)	-0.44	2 (0%) 88 76	28, 77, 172, 233	0
1	N	524/548 (95%)	-0.55	1 (0%) 91 83	22, 64, 152, 206	0
All	All	7336/7672 (95%)	-0.54	32 (0%) 88 76	18, 66, 167, 301	0

The worst 5 of 32 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	K	233	MET	3.8
1	K	342	ILE	3.8
1	K	193	MET	3.8
1	G	301	ILE	3.6
1	K	288	MET	3.1

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.