



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 5, 2026 – 09:14 PM UTC

PDB ID : 4WSC / pdb_00004wsc
Title : Crystal structure of a GroELK105A mutant
Authors : Lorimer, G.H.; Ye, X.; Fei, X.; Yang, D.; Corsepius, N.; LaRonde, N.A.
Deposited on : 2014-10-26
Resolution : 3.04 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

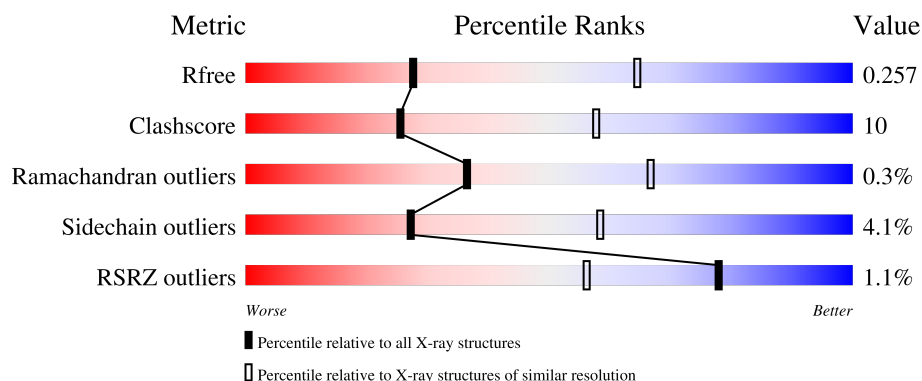
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.04 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	3685 (3.08-3.00)
Clashscore	190562	4007 (3.08-3.00)
Ramachandran outliers	187476	3834 (3.08-3.00)
Sidechain outliers	187428	3836 (3.08-3.00)
RSRZ outliers	180081	3684 (3.08-3.00)

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	2% 71% 22% • •
1	B	548	74% 19% • •
1	C	548	74% 19% • •
1	D	548	• 74% 19% • •
1	E	548	• 72% 20% • •

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Mol	Chain	Length	Quality of chain
1	F	548	70%23%
1	G	548	72%22%
1	H	548	% 71%22%
1	I	548	73%21%
1	J	548	70%24%
1	K	548	73%21%
1	L	548	7% 74%19%
1	M	548	% 70%24%
1	N	548	2% 72%21%

2 Entry composition

There is only 1 type of molecule in this entry. The entry contains 53914 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
			3851	2394	664	773	20			
1	B	524	Total	C	N	O	S	0	0	0
			3851	2394	664	773	20			
1	C	524	Total	C	N	O	S	0	0	0
			3851	2394	664	773	20			
1	D	524	Total	C	N	O	S	0	0	0
			3851	2394	664	773	20			
1	E	524	Total	C	N	O	S	0	0	0
			3851	2394	664	773	20			
1	F	524	Total	C	N	O	S	0	0	0
			3851	2394	664	773	20			
1	G	524	Total	C	N	O	S	0	0	0
			3851	2394	664	773	20			
1	H	524	Total	C	N	O	S	0	0	0
			3851	2394	664	773	20			
1	I	524	Total	C	N	O	S	0	0	0
			3851	2394	664	773	20			
1	J	524	Total	C	N	O	S	0	0	0
			3851	2394	664	773	20			
1	K	524	Total	C	N	O	S	0	0	0
			3851	2394	664	773	20			
1	L	524	Total	C	N	O	S	0	0	0
			3851	2394	664	773	20			
1	M	524	Total	C	N	O	S	0	0	0
			3851	2394	664	773	20			
1	N	524	Total	C	N	O	S	0	0	0
			3851	2394	664	773	20			

There are 14 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	105	ALA	LYS	engineered mutation	UNP P0A6F5

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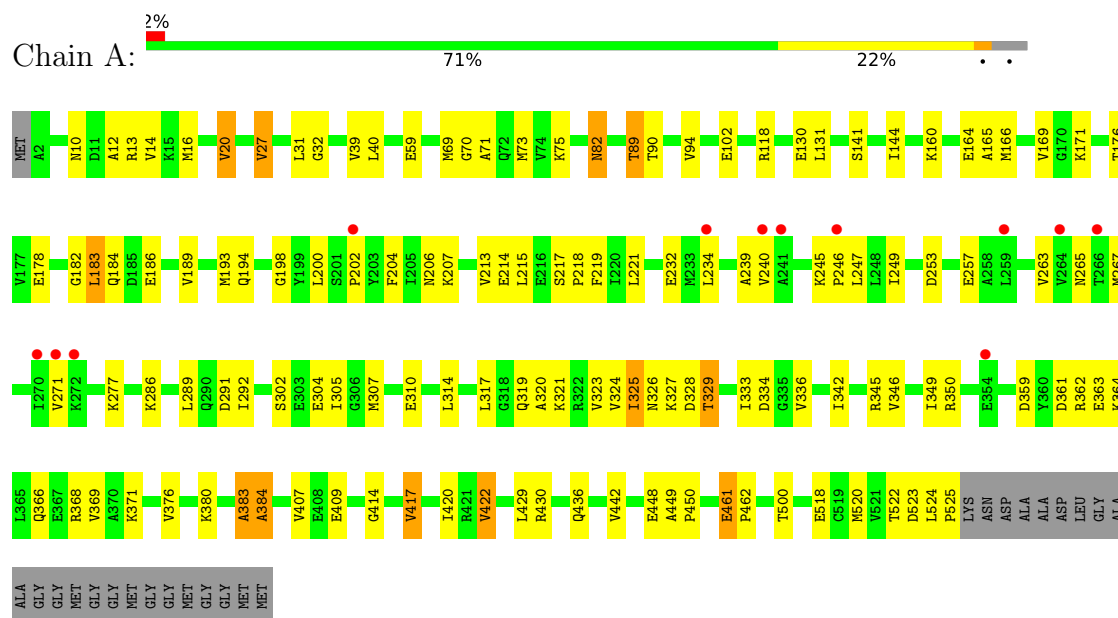
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Chain	Residue	Modelled	Actual	Comment	Reference
B	105	ALA	LYS	engineered mutation	UNP P0A6F5
C	105	ALA	LYS	engineered mutation	UNP P0A6F5
D	105	ALA	LYS	engineered mutation	UNP P0A6F5
E	105	ALA	LYS	engineered mutation	UNP P0A6F5
F	105	ALA	LYS	engineered mutation	UNP P0A6F5
G	105	ALA	LYS	engineered mutation	UNP P0A6F5
H	105	ALA	LYS	engineered mutation	UNP P0A6F5
I	105	ALA	LYS	engineered mutation	UNP P0A6F5
J	105	ALA	LYS	engineered mutation	UNP P0A6F5
K	105	ALA	LYS	engineered mutation	UNP P0A6F5
L	105	ALA	LYS	engineered mutation	UNP P0A6F5
M	105	ALA	LYS	engineered mutation	UNP P0A6F5
N	105	ALA	LYS	engineered mutation	UNP P0A6F5

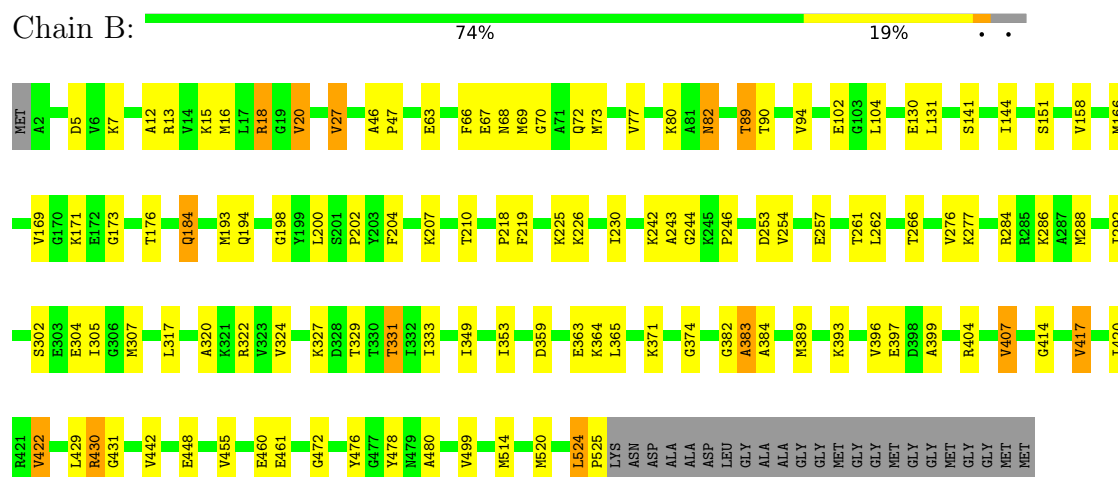
3 Residue-property plots [i](#)

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: 60 kDa chaperonin

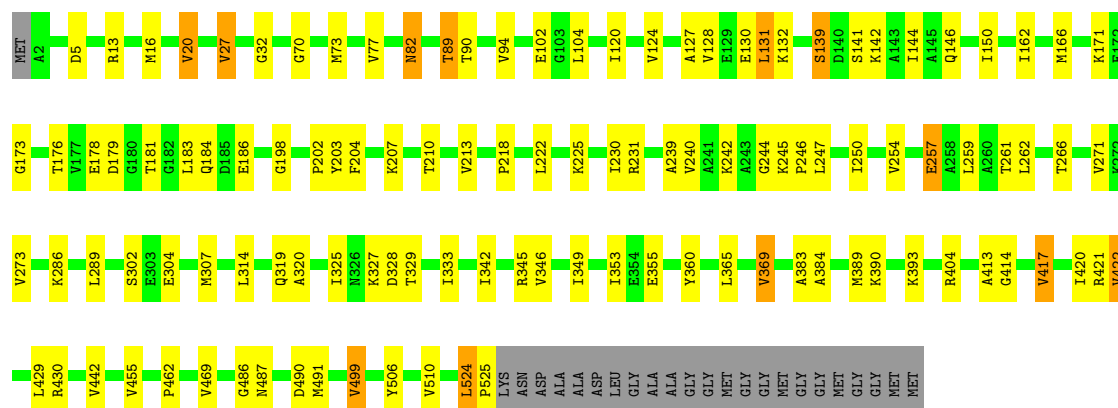


- Molecule 1: 60 kDa chaperonin



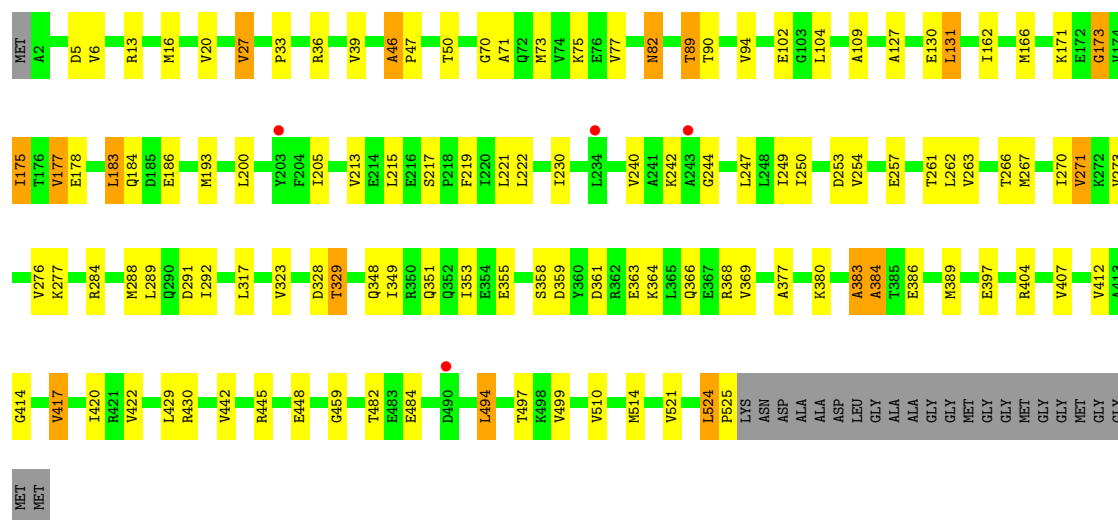
- Molecule 1: 60 kDa chaperonin

Chain C:  74% 19%



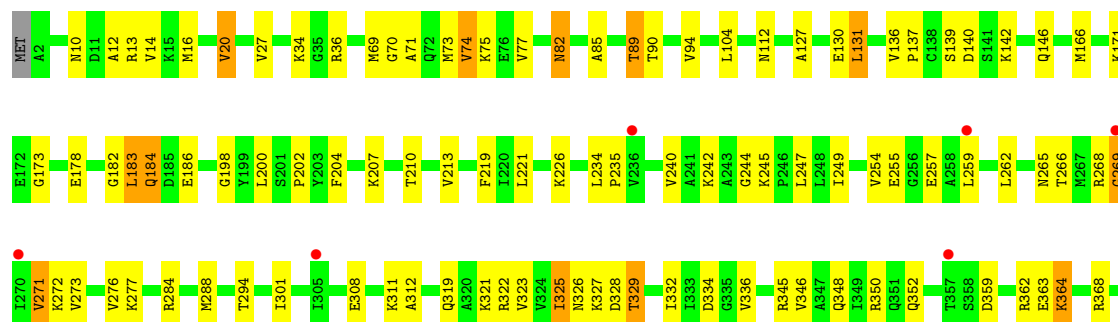
• Molecule 1: 60 kDa chaperonin

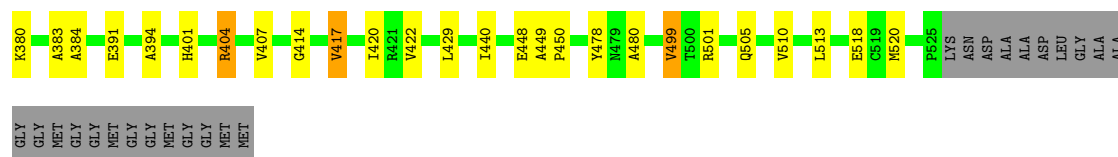
Chain D:  74% 19%



• Molecule 1: 60 kDa chaperonin

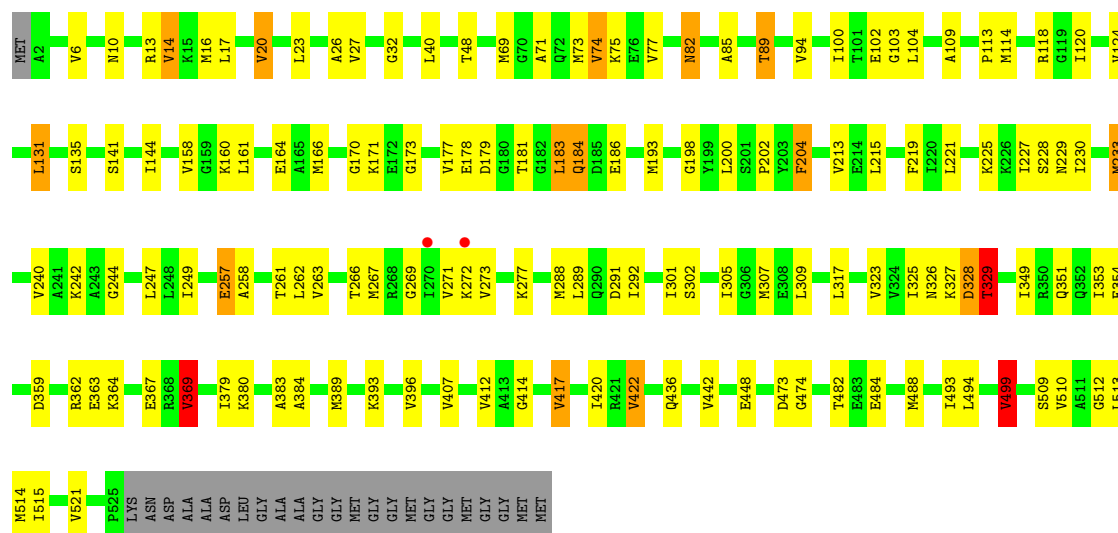
Chain E:  72% 20%





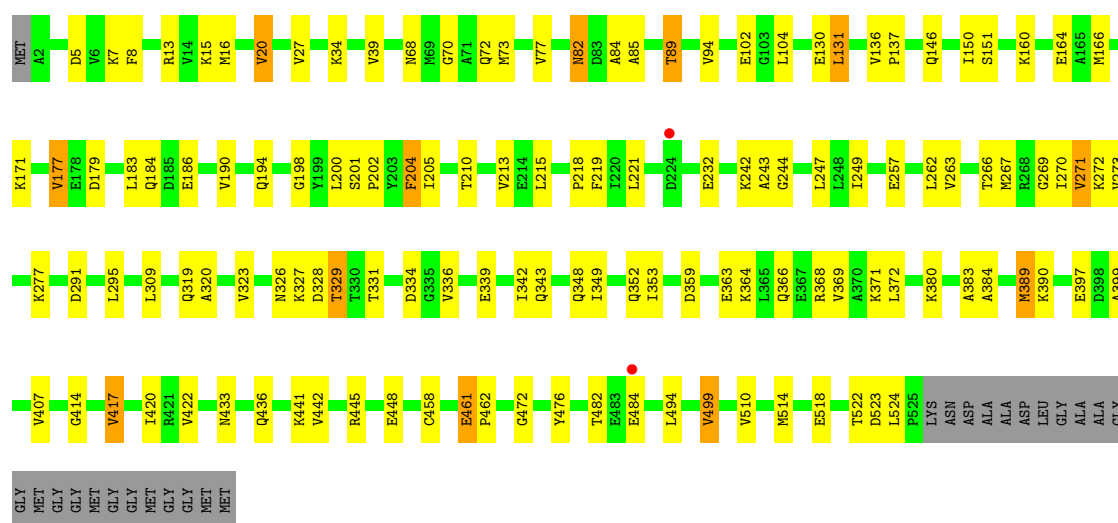
- Molecule 1: 60 kDa chaperonin

Chain F: 70% 23% . . .



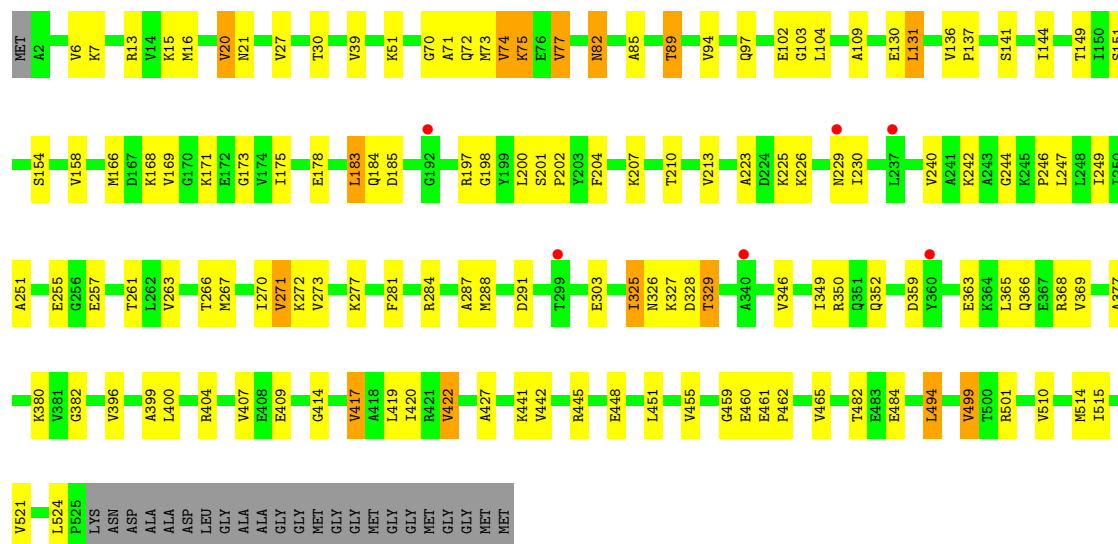
- Molecule 1: 60 kDa chaperonin

Chain G: 72% 22% . . .



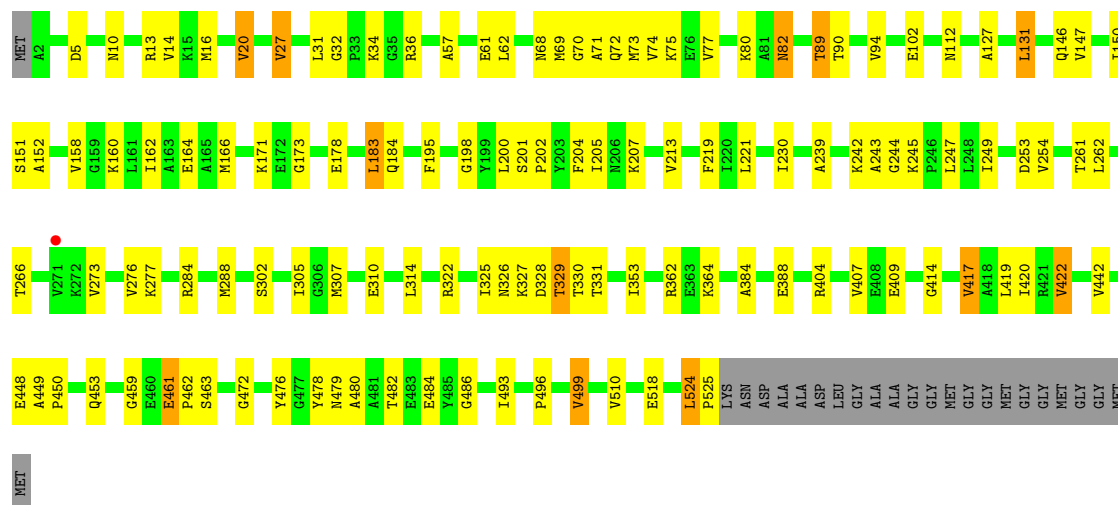
- Molecule 1: 60 kDa chaperonin

Chain H: 71% 22% . . .



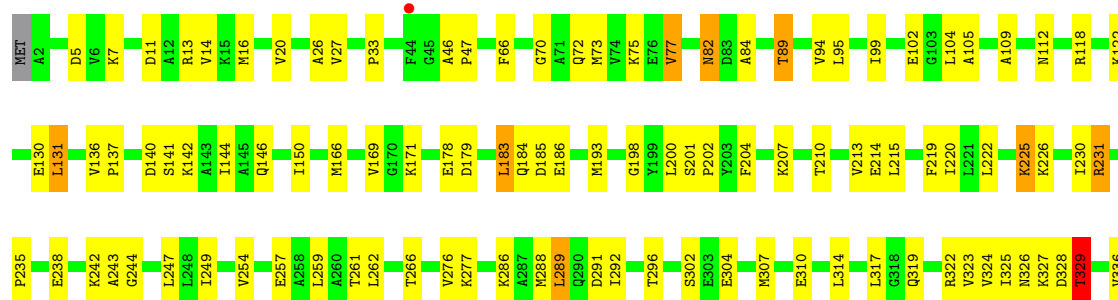
• Molecule 1: 60 kDa chaperonin

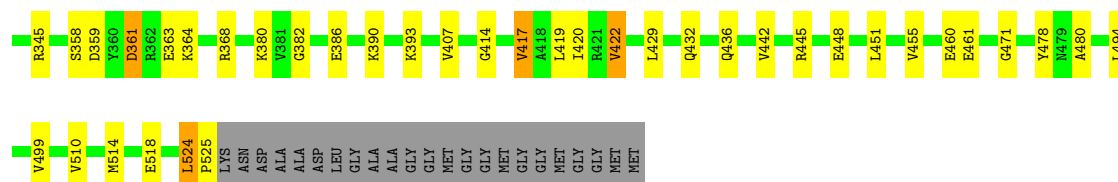
Chain I: 73% 21% . .



• Molecule 1: 60 kDa chaperonin

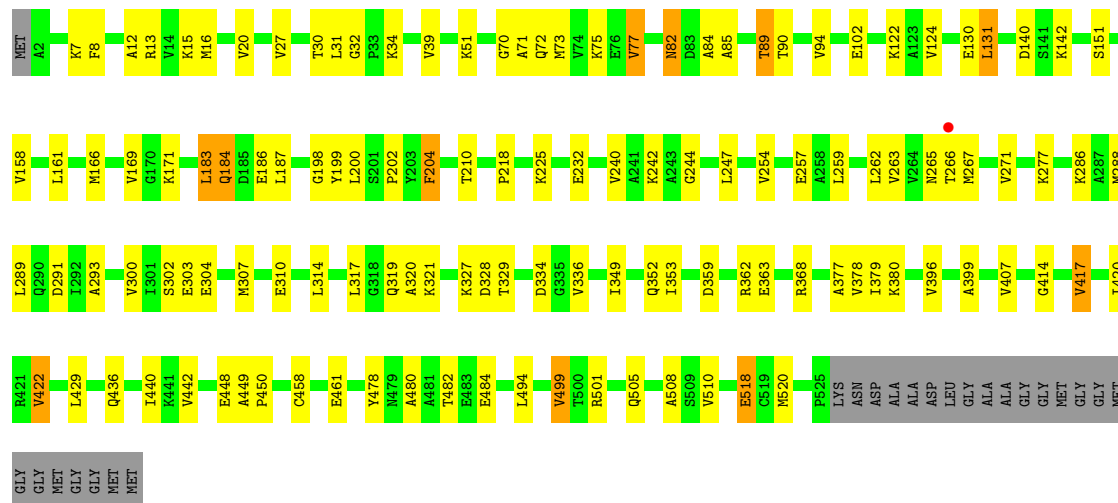
Chain J: 70% 24% . .



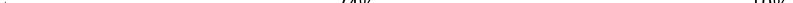


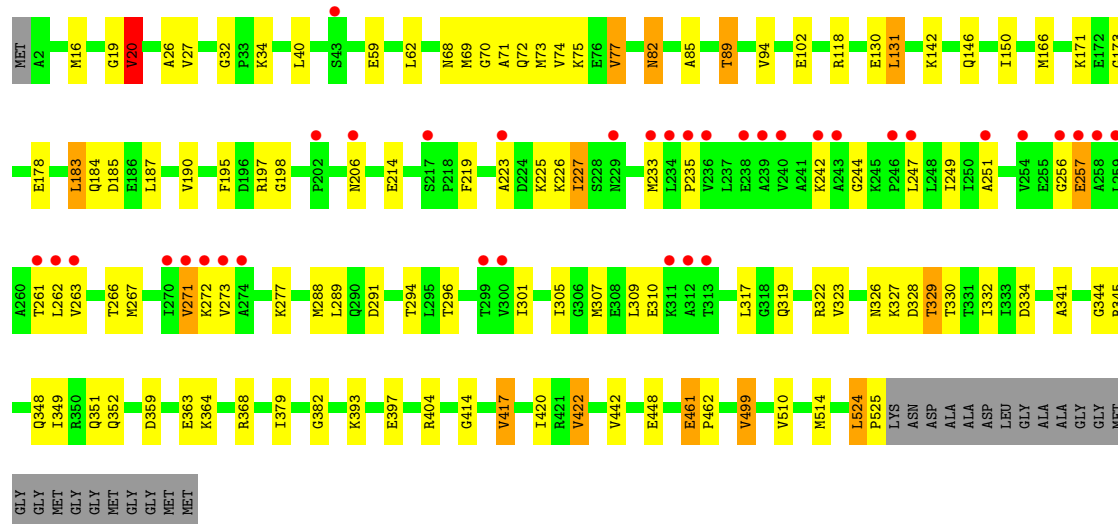
- Molecule 1: 60 kDa chaperonin

Chain K: 73% 21% . .

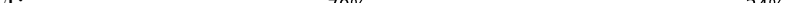


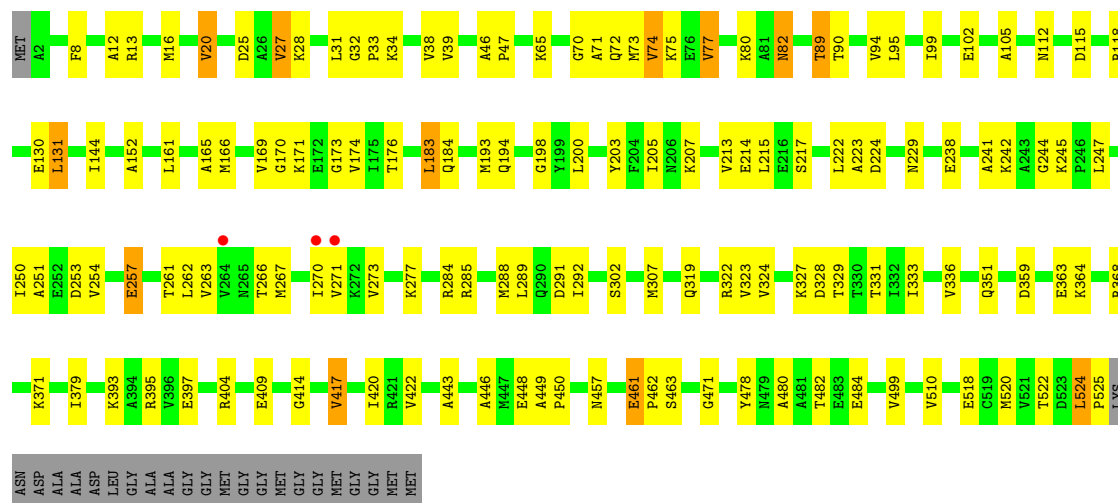
- Molecule 1: 60 kDa chaperonin

Chain L:  7% 74% 19%

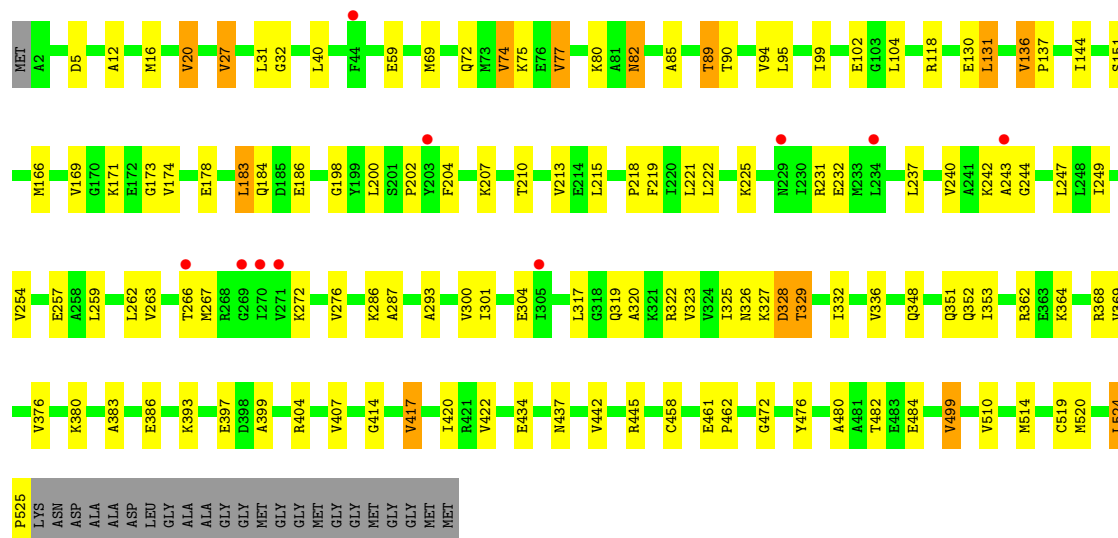
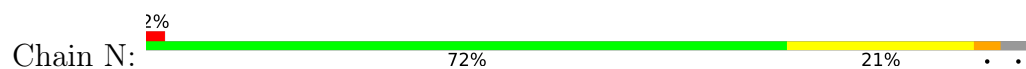


- Molecule 1: 60 kDa chaperonin

Chain M:  %



• Molecule 1: 60 kDa chaperonin



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	135.64Å 259.39Å 143.31Å 90.00° 105.12° 90.00°	Depositor
Resolution (Å)	80.52 – 3.04 80.52 – 3.04	Depositor EDS
% Data completeness (in resolution range)	98.4 (80.52-3.04) 96.2 (80.52-3.04)	Depositor EDS
R_{merge}	0.19	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.98 (at 3.01Å)	Xtriage
Refinement program	PHENIX (phenix.refine: 1.8.4_1496)	Depositor
R, R_{free}	0.190 , 0.256 0.194 , 0.257	Depositor DCC
R_{free} test set	2001 reflections (1.09%)	wwPDB-VP
Wilson B-factor (Å ²)	38.3	Xtriage
Anisotropy	0.870	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.31 , 54.6	EDS
L-test for twinning ²	$\langle L \rangle = 0.40$, $\langle L^2 \rangle = 0.23$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.91	EDS
Total number of atoms	53914	wwPDB-VP
Average B, all atoms (Å ²)	51.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.63% 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	0.68	0/3879	1.08	14/5239 (0.3%)
1	B	0.70	1/3879 (0.0%)	1.05	8/5239 (0.2%)
1	C	0.72	2/3879 (0.1%)	1.10	6/5239 (0.1%)
1	D	0.69	1/3879 (0.0%)	1.09	11/5239 (0.2%)
1	E	0.63	0/3879	1.06	9/5239 (0.2%)
1	F	0.71	1/3879 (0.0%)	1.08	9/5239 (0.2%)
1	G	0.65	0/3879	1.04	7/5239 (0.1%)
1	H	0.62	0/3879	1.01	4/5239 (0.1%)
1	I	0.66	0/3879	1.04	7/5239 (0.1%)
1	J	0.66	0/3879	1.08	10/5239 (0.2%)
1	K	0.65	0/3879	1.02	9/5239 (0.2%)
1	L	0.62	1/3879 (0.0%)	1.04	10/5239 (0.2%)
1	M	0.63	0/3879	1.03	11/5239 (0.2%)
1	N	0.63	0/3879	1.02	7/5239 (0.1%)
All	All	0.66	6/54306 (0.0%)	1.05	122/73346 (0.2%)

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	E	0	1

The worst 5 of 6 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	C	499	VAL	CA-CB	6.01	1.62	1.54
1	F	499	VAL	CA-CB	5.83	1.62	1.54
1	D	383	ALA	CA-CB	-5.72	1.46	1.54
1	C	139	SER	CA-C	-5.52	1.48	1.52
1	B	383	ALA	CA-CB	-5.42	1.44	1.53

The worst 5 of 122 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	E	269	GLY	N-CA-C	7.83	126.18	115.30
1	M	169	VAL	N-CA-C	7.42	120.18	112.83
1	N	207	LYS	CA-C-N	7.41	127.12	119.56
1	N	207	LYS	C-N-CA	7.41	127.12	119.56
1	C	32	GLY	CA-C-N	7.37	127.00	119.19

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	E	183	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	3851	0	3968	77	0
1	B	3851	0	3968	69	0
1	C	3851	0	3968	70	0
1	D	3851	0	3968	74	0
1	E	3851	0	3968	81	0
1	F	3851	0	3968	87	0
1	G	3851	0	3968	72	0
1	H	3851	0	3968	83	0
1	I	3851	0	3968	78	0
1	J	3851	0	3968	89	0
1	K	3851	0	3968	71	0
1	L	3851	0	3968	68	0
1	M	3851	0	3968	85	0
1	N	3851	0	3968	82	0
All	All	53914	0	55552	1048	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 1048 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:L:34:LYS:HE2	1:M:118:ARG:HH22	1.31	0.95
1:M:173:GLY:O	1:M:404:ARG:NH2	2.07	0.87
1:H:200:LEU:HD21	1:H:277:LYS:HG3	1.56	0.85
1:A:183:LEU:HG	1:A:384:ALA:HB2	1.60	0.83
1:N:524:LEU:HD12	1:N:525:PRO:HD2	1.61	0.82

There are no symmetry-related clashes.

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	522/548 (95%)	509 (98%)	11 (2%)	2 (0%)	30	61
1	B	522/548 (95%)	508 (97%)	12 (2%)	2 (0%)	30	61
1	C	522/548 (95%)	507 (97%)	14 (3%)	1 (0%)	43	73
1	D	522/548 (95%)	507 (97%)	11 (2%)	4 (1%)	16	46
1	E	522/548 (95%)	509 (98%)	11 (2%)	2 (0%)	30	61
1	F	522/548 (95%)	507 (97%)	13 (2%)	2 (0%)	30	61
1	G	522/548 (95%)	512 (98%)	7 (1%)	3 (1%)	21	53
1	H	522/548 (95%)	511 (98%)	10 (2%)	1 (0%)	43	73
1	I	522/548 (95%)	511 (98%)	10 (2%)	1 (0%)	43	73
1	J	522/548 (95%)	511 (98%)	10 (2%)	1 (0%)	43	73
1	K	522/548 (95%)	513 (98%)	8 (2%)	1 (0%)	43	73
1	L	522/548 (95%)	511 (98%)	10 (2%)	1 (0%)	43	73
1	M	522/548 (95%)	511 (98%)	11 (2%)	0	100	100
1	N	522/548 (95%)	510 (98%)	11 (2%)	1 (0%)	43	73
All	All	7308/7672 (95%)	7137 (98%)	149 (2%)	22 (0%)	36	67

5 of 22 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	C	184	GLN
1	B	184	GLN
1	D	184	GLN
1	F	184	GLN
1	G	243	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	403/414 (97%)	391 (97%)	12 (3%)	36	66
1	B	403/414 (97%)	387 (96%)	16 (4%)	28	59
1	C	403/414 (97%)	387 (96%)	16 (4%)	28	59
1	D	403/414 (97%)	388 (96%)	15 (4%)	30	61
1	E	403/414 (97%)	388 (96%)	15 (4%)	30	61
1	F	403/414 (97%)	385 (96%)	18 (4%)	24	56
1	G	403/414 (97%)	388 (96%)	15 (4%)	30	61
1	H	403/414 (97%)	384 (95%)	19 (5%)	23	55
1	I	403/414 (97%)	388 (96%)	15 (4%)	30	61
1	J	403/414 (97%)	384 (95%)	19 (5%)	23	55
1	K	403/414 (97%)	387 (96%)	16 (4%)	28	59
1	L	403/414 (97%)	385 (96%)	18 (4%)	24	56
1	M	403/414 (97%)	384 (95%)	19 (5%)	23	55
1	N	403/414 (97%)	385 (96%)	18 (4%)	24	56
All	All	5642/5796 (97%)	5411 (96%)	231 (4%)	27	58

5 of 231 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	H	131	LEU
1	N	183	LEU
1	J	77	VAL

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Mol	Chain	Res	Type
1	N	94	VAL
1	M	89	THR

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	I	229	ASN
1	L	153	ASN
1	I	475	ASN
1	J	352	GLN
1	M	475	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

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%)	-0.15	12 (2%) 61 37	13, 42, 126, 158	0
1	B	524/548 (95%)	-0.47	0 100 100	14, 36, 75, 112	0
1	C	524/548 (95%)	-0.61	0 100 100	12, 32, 65, 93	0
1	D	524/548 (95%)	-0.33	4 (0%) 82 63	11, 44, 93, 130	0
1	E	524/548 (95%)	-0.06	6 (1%) 78 56	18, 54, 125, 155	0
1	F	524/548 (95%)	-0.38	2 (0%) 88 76	15, 40, 94, 137	0
1	G	524/548 (95%)	-0.34	2 (0%) 88 76	19, 47, 86, 111	0
1	H	524/548 (95%)	-0.17	6 (1%) 78 56	18, 52, 105, 144	0
1	I	524/548 (95%)	-0.34	1 (0%) 91 83	14, 42, 83, 108	0
1	J	524/548 (95%)	-0.36	1 (0%) 91 83	18, 45, 77, 101	0
1	K	524/548 (95%)	-0.35	1 (0%) 91 83	18, 46, 86, 111	0
1	L	524/548 (95%)	0.12	36 (6%) 23 11	17, 57, 153, 189	0
1	M	524/548 (95%)	-0.27	3 (0%) 85 69	18, 49, 99, 120	0
1	N	524/548 (95%)	-0.16	10 (1%) 66 42	17, 55, 106, 140	0
All	All	7336/7672 (95%)	-0.28	84 (1%) 78 56	11, 44, 104, 189	0

The worst 5 of 84 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	L	240	VAL	4.2
1	L	233	MET	3.3
1	A	272	LYS	3.3
1	L	234	LEU	3.2
1	A	240	VAL	3.2

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.