



wwPDB EM Map/Model Validation Report ⓘ

Apr 10, 2016 – 02:00 PM BST

PDB ID : 3J9I
EMDB ID: : EMD-5623
Title : Thermoplasma acidophilum 20S proteasome
Authors : Li, X.; Mooney, P.; Zheng, S.; Booth, C.; Braunfeld, M.B.; Gubbens, S.; Agard, D.A.; Cheng, Y.
Deposited on : 2015-02-02
Resolution : 3.30 Å(reported)
Based on PDB ID : 1PMA

This is a wwPDB EM Map/Model Validation Report for a publicly released PDB/EMDB entry.
For rigid body fitted models, validation errors reported here could stem from errors in the original structure(s) used in the fitting.
We welcome your comments at validation@mail.wwpdb.org
A user guide is available at
<http://wwpdb.org/validation/2016/EMValidationReportHelp>

MolProbity : 4.02b-467
Mogul : unknown
Percentile statistics : 20151230.v01 (using entries in the PDB archive December 30th 2015)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et. al. (1996)
Validation Pipeline (wwPDB-VP) : trunk27241

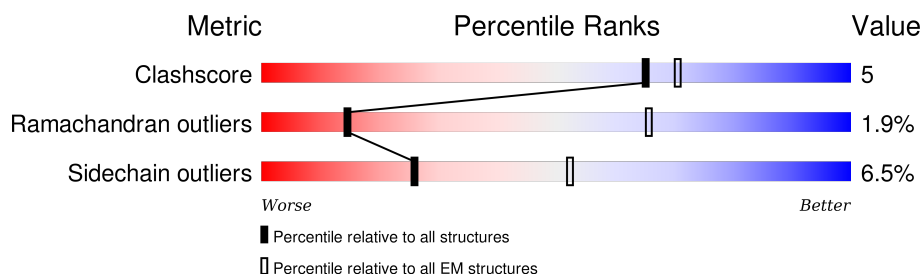
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

ELECTRON MICROSCOPY

The reported resolution of this entry is 3.30 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.
















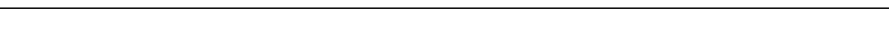





Metric	Whole archive (#Entries)	EM structures (#Entries)
Clashscore	114402	924
Ramachandran outliers	111179	726
Sidechain outliers	111093	686

The table below summarises the geometric issues observed across the polymeric chains. The red, orange, yellow and green segments on the bar indicate the fraction of residues that contain outliers for ≥ 3 , 2, 1 and 0 types of geometric quality criteria. 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 $\leq 5\%$.

Mol	Chain	Length	Quality of chain
1	A	224	74% 21% .
1	B	224	74% 21% .
1	C	224	74% 21% .
1	D	224	74% 21% .
1	E	224	74% 21% .
1	F	224	74% 21% .
1	G	224	74% 21% .
1	O	224	74% 21% .
1	P	224	74% 21% .

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Mol	Chain	Length	Quality of chain
1	Q	224	
1	R	224	
1	S	224	
1	T	224	
1	U	224	
2	1	203	
2	2	203	
2	H	203	
2	I	203	
2	J	203	
2	K	203	
2	L	203	
2	M	203	
2	N	203	
2	V	203	
2	W	203	
2	X	203	
2	Y	203	
2	Z	203	

2 Entry composition

There are 2 unique types of molecules in this entry. The entry contains 46228 atoms, of which 0 are hydrogens and 0 are deuteriums.

In the tables below, 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 Proteasome subunit alpha.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	S	224	Total	C	N	O	S	0	0
			1744	1107	296	338	3		
1	F	224	Total	C	N	O	S	0	0
			1744	1107	296	338	3		
1	T	224	Total	C	N	O	S	0	0
			1744	1107	296	338	3		
1	G	224	Total	C	N	O	S	0	0
			1744	1107	296	338	3		
1	U	224	Total	C	N	O	S	0	0
			1744	1107	296	338	3		
1	A	224	Total	C	N	O	S	0	0
			1744	1107	296	338	3		
1	O	224	Total	C	N	O	S	0	0
			1744	1107	296	338	3		
1	B	224	Total	C	N	O	S	0	0
			1744	1107	296	338	3		
1	P	224	Total	C	N	O	S	0	0
			1744	1107	296	338	3		
1	C	224	Total	C	N	O	S	0	0
			1744	1107	296	338	3		
1	Q	224	Total	C	N	O	S	0	0
			1744	1107	296	338	3		
1	D	224	Total	C	N	O	S	0	0
			1744	1107	296	338	3		
1	R	224	Total	C	N	O	S	0	0
			1744	1107	296	338	3		
1	E	224	Total	C	N	O	S	0	0
			1744	1107	296	338	3		

- Molecule 2 is a protein called Proteasome subunit beta.

Mol	Chain	Residues	Atoms					AltConf	Trace
2	Z	203	Total	C	N	O	S	0	0
			1558	985	264	298	11		

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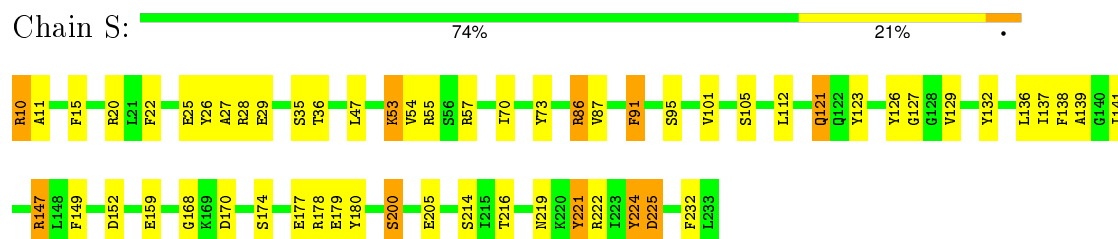
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Mol	Chain	Residues	Atoms					AltConf	Trace
2	M	203	Total	C	N	O	S	0	0
			1558	985	264	298	11		
2	1	203	Total	C	N	O	S	0	0
			1558	985	264	298	11		
2	N	203	Total	C	N	O	S	0	0
			1558	985	264	298	11		
2	2	203	Total	C	N	O	S	0	0
			1558	985	264	298	11		
2	H	203	Total	C	N	O	S	0	0
			1558	985	264	298	11		
2	V	203	Total	C	N	O	S	0	0
			1558	985	264	298	11		
2	I	203	Total	C	N	O	S	0	0
			1558	985	264	298	11		
2	W	203	Total	C	N	O	S	0	0
			1558	985	264	298	11		
2	J	203	Total	C	N	O	S	0	0
			1558	985	264	298	11		
2	X	203	Total	C	N	O	S	0	0
			1558	985	264	298	11		
2	K	203	Total	C	N	O	S	0	0
			1558	985	264	298	11		
2	Y	203	Total	C	N	O	S	0	0
			1558	985	264	298	11		
2	L	203	Total	C	N	O	S	0	0
			1558	985	264	298	11		

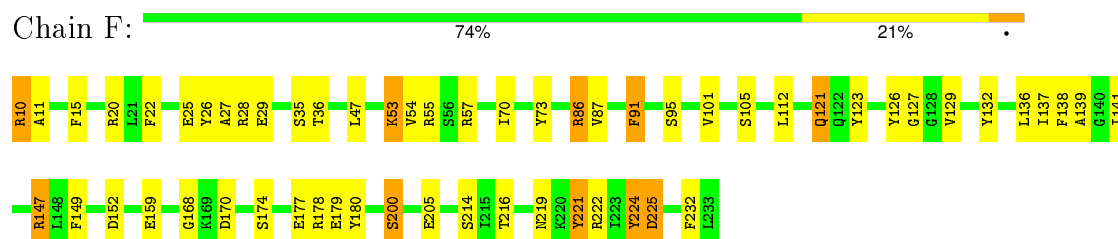
3 Residue-property plots

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of errors displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry. 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. 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.

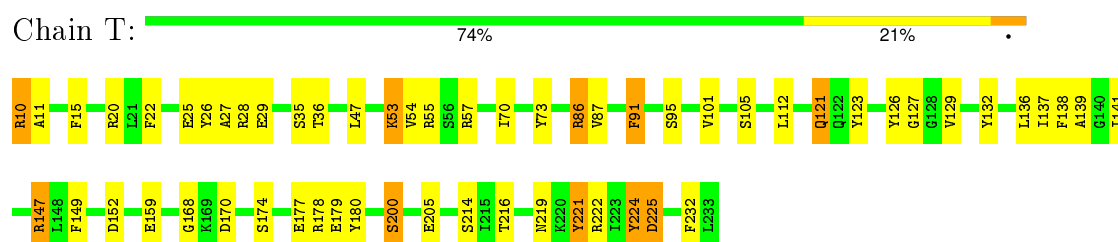
- Molecule 1: Proteasome subunit alpha



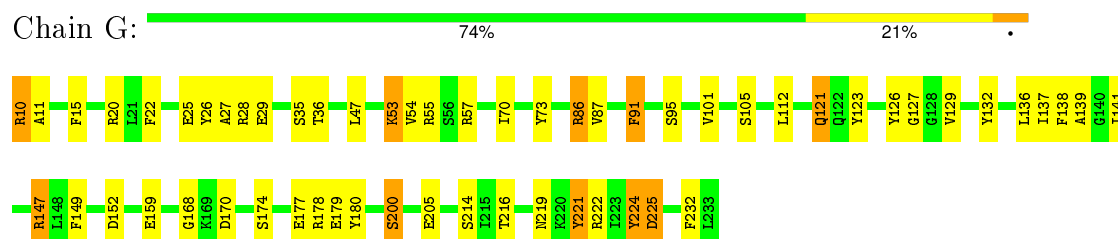
- Molecule 1: Proteasome subunit alpha



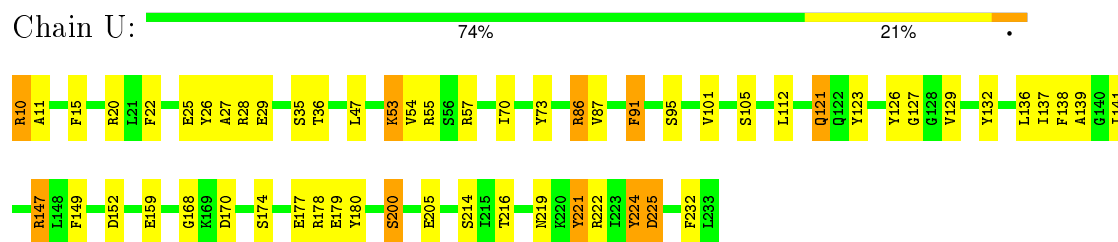
- Molecule 1: Proteasome subunit alpha



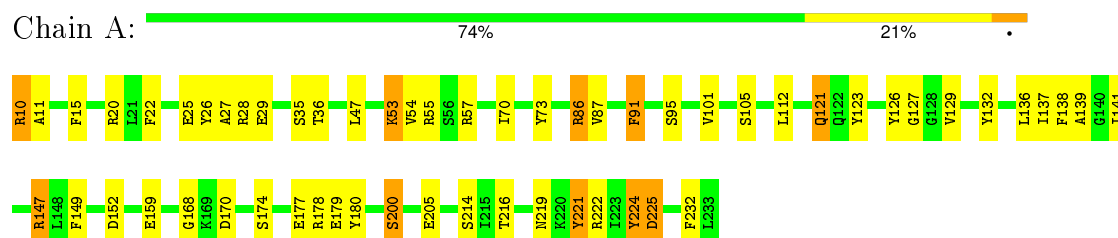
- Molecule 1: Proteasome subunit alpha



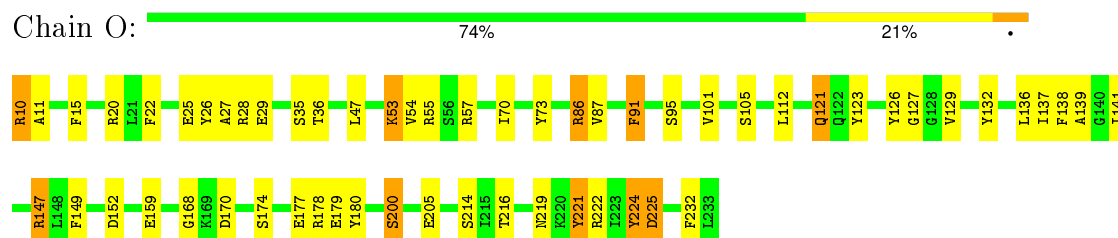
- Molecule 1: Proteasome subunit alpha



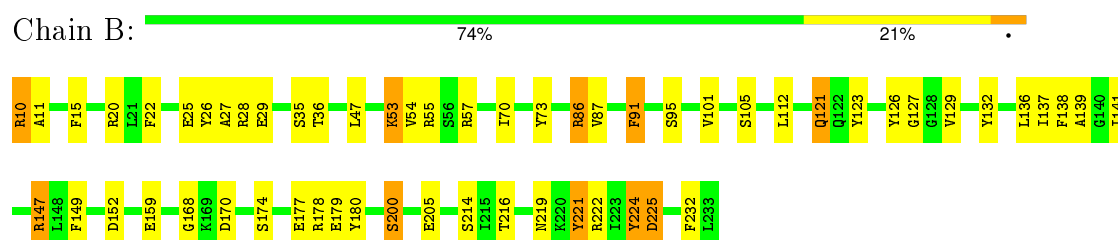
- Molecule 1: Proteasome subunit alpha



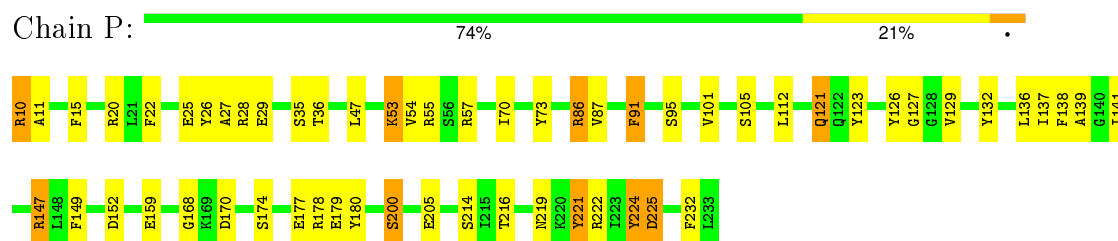
- Molecule 1: Proteasome subunit alpha



- Molecule 1: Proteasome subunit alpha

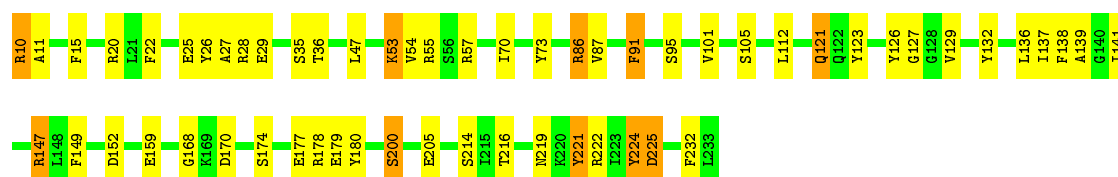


- Molecule 1: Proteasome subunit alpha

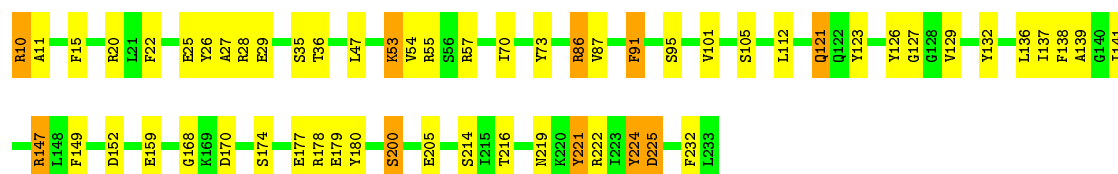


- Molecule 1: Proteasome subunit alpha

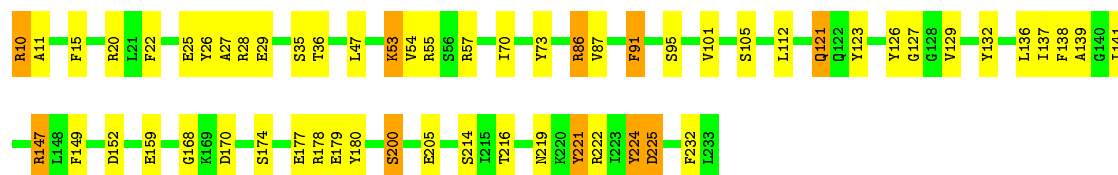
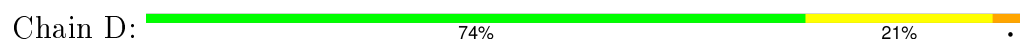




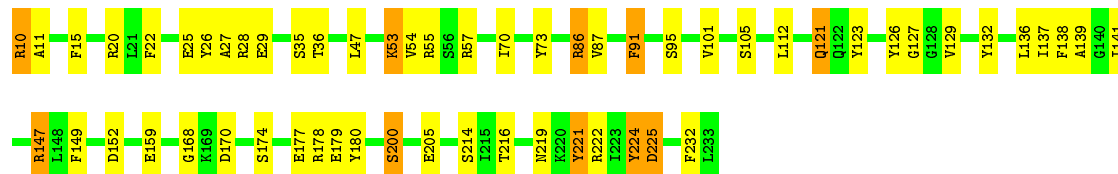
- Molecule 1: Proteasome subunit alpha



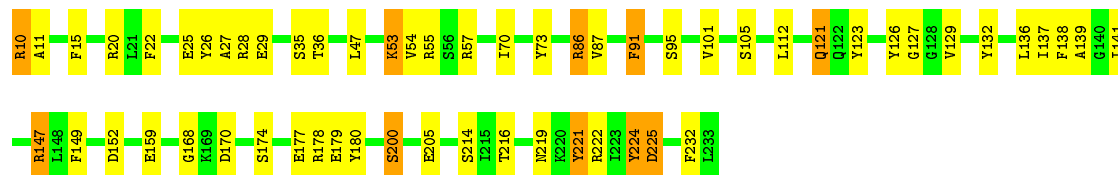
- Molecule 1: Proteasome subunit alpha



- Molecule 1: Proteasome subunit alpha

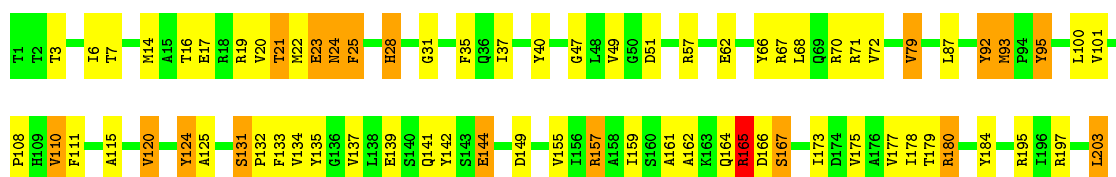


- Molecule 1: Proteasome subunit alpha



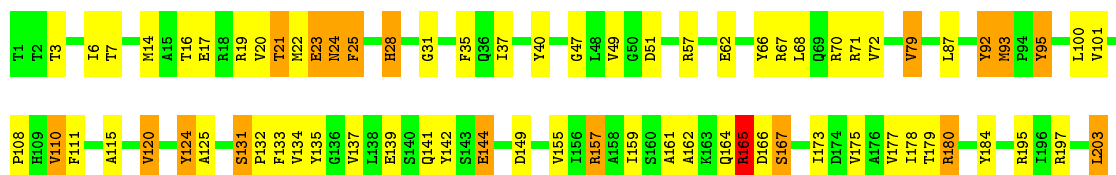
- Molecule 2: Proteasome subunit beta





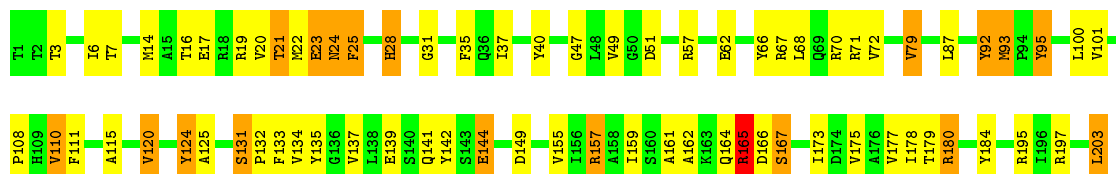
- Molecule 2: Proteasome subunit beta

Chain M:



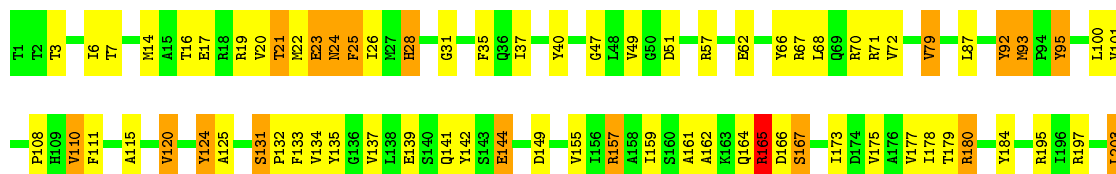
- Molecule 2: Proteasome subunit beta

Chain 1:



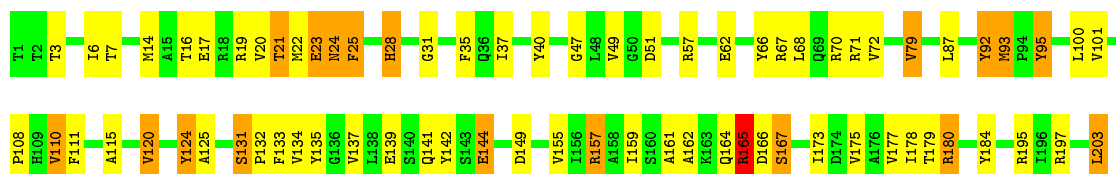
- Molecule 2: Proteasome subunit beta

Chain N:



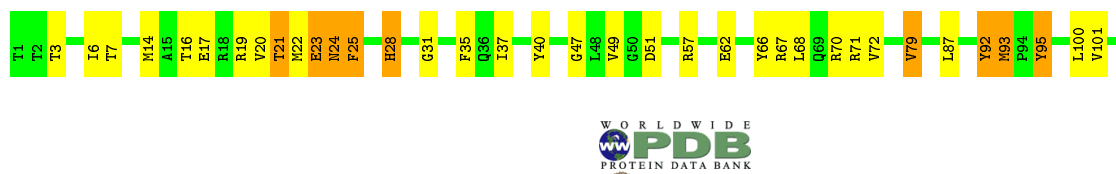
- Molecule 2: Proteasome subunit beta

Chain 2:



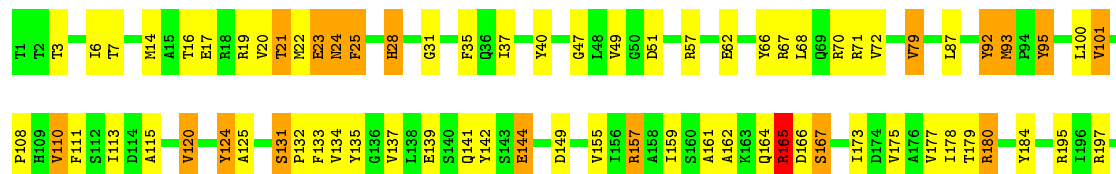
- Molecule 2: Proteasome subunit beta

Chain H:

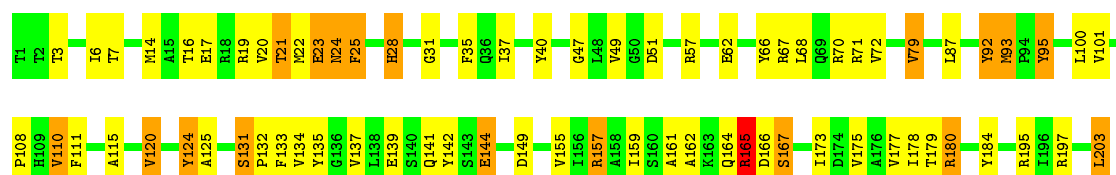




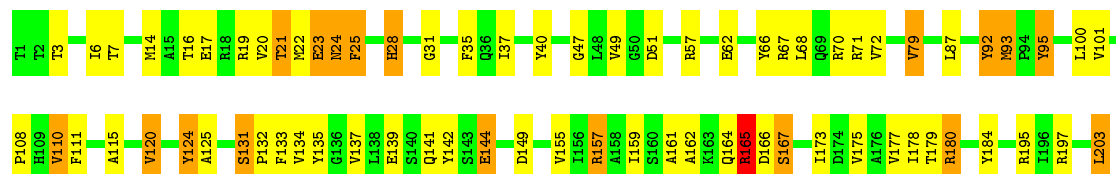
• Molecule 2: Proteasome subunit beta



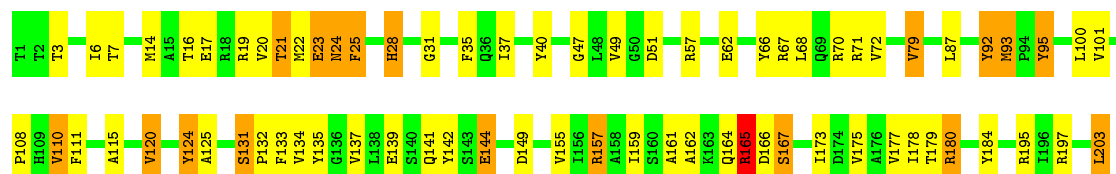
• Molecule 2: Proteasome subunit beta



• Molecule 2: Proteasome subunit beta



• Molecule 2: Proteasome subunit beta



• Molecule 2: Proteasome subunit beta





• Molecule 2: Proteasome subunit beta



• Molecule 2: Proteasome subunit beta



• Molecule 2: Proteasome subunit beta



4 Experimental information

Property	Value	Source
Reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	Depositor
Number of images	126729	Depositor
Resolution determination method	FSC 0.143	Depositor
CTF correction method	Each Particle	Depositor
Microscope	FEI POLARA 300	Depositor
Voltage (kV)	300	Depositor
Electron dose ($e^-/\text{\AA}^2$)	20	Depositor
Minimum defocus (nm)	800	Depositor
Maximum defocus (nm)	1900	Depositor
Magnification	31000	Depositor
Image detector	GATAN K2 (4k x 4k)	Depositor

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 >2	RMSZ	# Z >2
1	A	1.73	19/1767 (1.1%)	2.01	45/2380 (1.9%)
1	B	1.73	19/1767 (1.1%)	2.01	44/2380 (1.8%)
1	C	1.73	17/1767 (1.0%)	2.01	45/2380 (1.9%)
1	D	1.73	19/1767 (1.1%)	2.01	45/2380 (1.9%)
1	E	1.73	19/1767 (1.1%)	2.01	44/2380 (1.8%)
1	F	1.73	18/1767 (1.0%)	2.01	45/2380 (1.9%)
1	G	1.73	19/1767 (1.1%)	2.01	44/2380 (1.8%)
1	O	1.73	17/1767 (1.0%)	2.01	44/2380 (1.8%)
1	P	1.73	19/1767 (1.1%)	2.01	45/2380 (1.9%)
1	Q	1.73	19/1767 (1.1%)	2.01	44/2380 (1.8%)
1	R	1.73	19/1767 (1.1%)	2.01	45/2380 (1.9%)
1	S	1.73	19/1767 (1.1%)	2.01	44/2380 (1.8%)
1	T	1.73	18/1767 (1.0%)	2.01	45/2380 (1.9%)
1	U	1.73	17/1767 (1.0%)	2.01	45/2380 (1.9%)
2	1	1.66	12/1577 (0.8%)	2.08	53/2129 (2.5%)
2	2	1.66	12/1577 (0.8%)	2.08	53/2129 (2.5%)
2	H	1.66	12/1577 (0.8%)	2.08	53/2129 (2.5%)
2	I	1.66	12/1577 (0.8%)	2.08	53/2129 (2.5%)
2	J	1.66	12/1577 (0.8%)	2.08	53/2129 (2.5%)
2	K	1.66	12/1577 (0.8%)	2.08	53/2129 (2.5%)
2	L	1.66	12/1577 (0.8%)	2.08	53/2129 (2.5%)
2	M	1.66	12/1577 (0.8%)	2.08	53/2129 (2.5%)
2	N	1.66	12/1577 (0.8%)	2.08	53/2129 (2.5%)
2	V	1.66	12/1577 (0.8%)	2.08	53/2129 (2.5%)
2	W	1.66	12/1577 (0.8%)	2.08	53/2129 (2.5%)
2	X	1.66	12/1577 (0.8%)	2.08	53/2129 (2.5%)
2	Y	1.66	12/1577 (0.8%)	2.08	53/2129 (2.5%)
2	Z	1.66	12/1577 (0.8%)	2.08	53/2129 (2.5%)
All	All	1.70	426/46816 (0.9%)	2.04	1366/63126 (2.2%)

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	A	0	4
1	B	0	4
1	C	0	4
1	D	0	4
1	E	0	4
1	F	0	4
1	G	0	4
1	O	0	4
1	P	0	4
1	Q	0	4
1	R	0	4
1	S	0	4
1	T	0	4
1	U	0	4
2	1	0	8
2	2	0	8
2	H	0	8
2	I	0	8
2	J	0	8
2	K	0	8
2	L	0	8
2	M	0	8
2	N	0	8
2	V	0	8
2	W	0	8
2	X	0	8
2	Y	0	8
2	Z	0	8
All	All	0	168

The worst 5 of 426 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	2	92	TYR	CG-CD1	8.79	1.50	1.39
2	Z	92	TYR	CG-CD1	8.78	1.50	1.39
2	M	92	TYR	CG-CD1	8.78	1.50	1.39
2	1	92	TYR	CG-CD1	8.78	1.50	1.39
2	I	92	TYR	CG-CD1	8.78	1.50	1.39

The worst 5 of 1366 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	1	135	TYR	CB-CG-CD1	-14.47	112.32	121.00

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	X	135	TYR	CB-CG-CD1	-14.46	112.33	121.00
2	W	135	TYR	CB-CG-CD1	-14.44	112.33	121.00
2	2	135	TYR	CB-CG-CD1	-14.42	112.35	121.00
2	K	135	TYR	CB-CG-CD1	-14.42	112.35	121.00

There are no chirality outliers.

5 of 168 planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	S	147	ARG	Sidechain
1	S	20	ARG	Sidechain
1	S	86	ARG	Sidechain
1	S	91	PHE	Sidechain
2	Z	24	ASN	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	1744	0	1782	23	0
1	B	1744	0	1782	23	0
1	C	1744	0	1782	23	0
1	D	1744	0	1782	23	0
1	E	1744	0	1782	23	0
1	F	1744	0	1782	24	0
1	G	1744	0	1782	23	0
1	O	1744	0	1782	23	0
1	P	1744	0	1782	24	0
1	Q	1744	0	1782	23	0
1	R	1744	0	1782	23	0
1	S	1744	0	1782	23	0
1	T	1744	0	1782	23	0
1	U	1744	0	1782	23	0
2	1	1558	0	1609	31	0
2	2	1558	0	1609	31	0
2	H	1558	0	1609	32	0
2	I	1558	0	1609	31	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	J	1558	0	1609	31	0
2	K	1558	0	1609	31	0
2	L	1558	0	1609	31	0
2	M	1558	0	1609	30	0
2	N	1558	0	1609	31	0
2	V	1558	0	1609	32	0
2	W	1558	0	1609	30	0
2	X	1558	0	1609	31	0
2	Y	1558	0	1609	32	0
2	Z	1558	0	1609	31	0
All	All	46228	0	47474	479	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 479 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:S:11:ALA:CB	1:T:10:ARG:CZ	1.95	1.44
1:B:11:ALA:CB	1:C:10:ARG:CZ	1.95	1.43
1:T:11:ALA:CB	1:U:10:ARG:CZ	1.95	1.43
1:A:11:ALA:CB	1:B:10:ARG:CZ	1.95	1.43
1:S:10:ARG:CZ	1:R:11:ALA:CB	1.95	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 PDB entries followed by that with respect to all EM entries.

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	222/224 (99%)	199 (90%)	21 (10%)	2 (1%)	21 60
1	B	222/224 (99%)	199 (90%)	21 (10%)	2 (1%)	21 60

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	C	222/224 (99%)	199 (90%)	21 (10%)	2 (1%)	21	60
1	D	222/224 (99%)	199 (90%)	21 (10%)	2 (1%)	21	60
1	E	222/224 (99%)	199 (90%)	21 (10%)	2 (1%)	21	60
1	F	222/224 (99%)	199 (90%)	21 (10%)	2 (1%)	21	60
1	G	222/224 (99%)	199 (90%)	21 (10%)	2 (1%)	21	60
1	O	222/224 (99%)	199 (90%)	21 (10%)	2 (1%)	21	60
1	P	222/224 (99%)	199 (90%)	21 (10%)	2 (1%)	21	60
1	Q	222/224 (99%)	199 (90%)	21 (10%)	2 (1%)	21	60
1	R	222/224 (99%)	199 (90%)	21 (10%)	2 (1%)	21	60
1	S	222/224 (99%)	199 (90%)	21 (10%)	2 (1%)	21	60
1	T	222/224 (99%)	199 (90%)	21 (10%)	2 (1%)	21	60
1	U	222/224 (99%)	199 (90%)	21 (10%)	2 (1%)	21	60
2	1	201/203 (99%)	182 (90%)	13 (6%)	6 (3%)	5	33
2	2	201/203 (99%)	182 (90%)	13 (6%)	6 (3%)	5	33
2	H	201/203 (99%)	182 (90%)	13 (6%)	6 (3%)	5	33
2	I	201/203 (99%)	182 (90%)	13 (6%)	6 (3%)	5	33
2	J	201/203 (99%)	182 (90%)	13 (6%)	6 (3%)	5	33
2	K	201/203 (99%)	182 (90%)	13 (6%)	6 (3%)	5	33
2	L	201/203 (99%)	182 (90%)	13 (6%)	6 (3%)	5	33
2	M	201/203 (99%)	182 (90%)	13 (6%)	6 (3%)	5	33
2	N	201/203 (99%)	182 (90%)	13 (6%)	6 (3%)	5	33
2	V	201/203 (99%)	182 (90%)	13 (6%)	6 (3%)	5	33
2	W	201/203 (99%)	182 (90%)	13 (6%)	6 (3%)	5	33
2	X	201/203 (99%)	182 (90%)	13 (6%)	6 (3%)	5	33
2	Y	201/203 (99%)	182 (90%)	13 (6%)	6 (3%)	5	33
2	Z	201/203 (99%)	182 (90%)	13 (6%)	6 (3%)	5	33
All	All	5922/5978 (99%)	5334 (90%)	476 (8%)	112 (2%)	14	45

5 of 112 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
2	Z	25	PHE
2	M	25	PHE

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Mol	Chain	Res	Type
2	1	25	PHE
2	N	25	PHE
2	2	25	PHE

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 PDB entries followed by that with respect to all EM entries.

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	186/186 (100%)	174 (94%)	12 (6%)	21	59
1	B	186/186 (100%)	174 (94%)	12 (6%)	21	59
1	C	186/186 (100%)	174 (94%)	12 (6%)	21	59
1	D	186/186 (100%)	174 (94%)	12 (6%)	21	59
1	E	186/186 (100%)	174 (94%)	12 (6%)	21	59
1	F	186/186 (100%)	174 (94%)	12 (6%)	21	59
1	G	186/186 (100%)	174 (94%)	12 (6%)	21	59
1	O	186/186 (100%)	174 (94%)	12 (6%)	21	59
1	P	186/186 (100%)	174 (94%)	12 (6%)	21	59
1	Q	186/186 (100%)	174 (94%)	12 (6%)	21	59
1	R	186/186 (100%)	174 (94%)	12 (6%)	21	59
1	S	186/186 (100%)	174 (94%)	12 (6%)	21	59
1	T	186/186 (100%)	174 (94%)	12 (6%)	21	59
1	U	186/186 (100%)	174 (94%)	12 (6%)	21	59
2	1	170/170 (100%)	159 (94%)	11 (6%)	21	59
2	2	170/170 (100%)	159 (94%)	11 (6%)	21	59
2	H	170/170 (100%)	159 (94%)	11 (6%)	21	59
2	I	170/170 (100%)	159 (94%)	11 (6%)	21	59
2	J	170/170 (100%)	159 (94%)	11 (6%)	21	59
2	K	170/170 (100%)	159 (94%)	11 (6%)	21	59
2	L	170/170 (100%)	159 (94%)	11 (6%)	21	59

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
2	M	170/170 (100%)	159 (94%)	11 (6%)	21	59
2	N	170/170 (100%)	159 (94%)	11 (6%)	21	59
2	V	170/170 (100%)	159 (94%)	11 (6%)	21	59
2	W	170/170 (100%)	159 (94%)	11 (6%)	21	59
2	X	170/170 (100%)	159 (94%)	11 (6%)	21	59
2	Y	170/170 (100%)	159 (94%)	11 (6%)	21	59
2	Z	170/170 (100%)	159 (94%)	11 (6%)	21	59
All	All	4984/4984 (100%)	4662 (94%)	322 (6%)	26	59

5 of 322 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	O	216	THR
2	I	144	GLU
2	Y	178	ILE
1	O	225	ASP
1	B	121	GLN

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 35 such sidechains are listed below:

Mol	Chain	Res	Type
1	O	121	GLN
2	I	141	GLN
1	E	121	GLN
2	V	141	GLN
2	V	191	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 [i](#)

There are no carbohydrates 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.