



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 9, 2026 – 05:48 AM UTC

PDB ID : 4Y9Z / pdb_00004y9z
Title : Yeast 20S proteasome beta2-H116E mutant in complex with Ac-LAE-ep
Authors : Huber, E.M.; Groll, M.
Deposited on : 2015-02-17
Resolution : 2.80 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
Mogul : 2022.3.0, CSD as543be (2022)
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

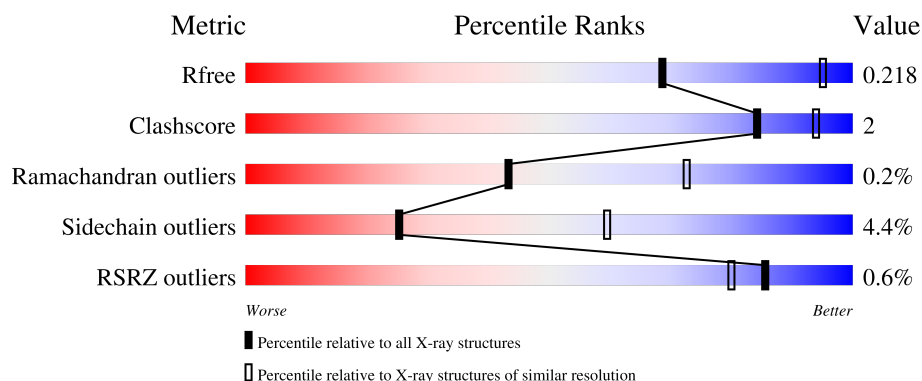
1 Overall quality at a glance ⓘ

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.80 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	3866 (2.80-2.80)
Clashscore	190562	4276 (2.80-2.80)
Ramachandran outliers	187476	4196 (2.80-2.80)
Sidechain outliers	187428	4198 (2.80-2.80)
RSRZ outliers	180081	3869 (2.80-2.80)

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	250	93% 6%
1	O	250	93% 6%
2	B	258	2% 85% 9% • 5%
2	P	258	% 85% 9% • 5%
3	C	254	% 87% 6% • 6%

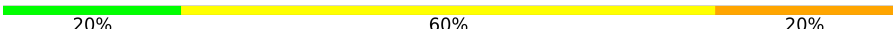
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Mol	Chain	Length	Quality of chain
3	Q	254	 3% 87% 6% • 6%
4	D	260	 % 81% 9% • 10%
4	R	260	 % 80% 10% • 10%
5	E	234	 88% 10% ••
5	S	234	 87% 11% ••
6	F	288	 % 81% • 16%
6	T	288	 % 80% • 16%
7	G	252	 88% 6% ••
7	U	252	 87% 7% ••
8	H	232	 88% 7% •
8	V	232	 89% 6% •
9	I	205	 93% 6%
9	W	205	 93% 6%
10	J	198	 % 89% 8% ••
10	X	198	 % 89% 8% ••
11	K	212	 89% 11%
11	Y	212	 89% 10%
12	L	222	 92% 7% •
12	Z	222	 91% 8% •
13	M	246	 87% 8% 5%
13	a	246	 87% 7% 5%
14	N	196	 94% 6%
14	b	196	 93% 7%
15	1	5	 40% 40% 20%
15	2	5	 40% 40% 20%

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Mol	Chain	Length	Quality of chain
15	3	5	 80%20%
15	4	5	 60%20%20%
15	5	5	 80%20%
15	6	5	 20%60%20%

2 Entry composition

There are 19 unique types of molecules in this entry. The entry contains 49850 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 Proteasome subunit alpha type-2.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	250	Total	C	N	O	S	0	0	0
			1915	1219	315	377	4			
1	O	250	Total	C	N	O	S	0	0	0
			1915	1219	315	377	4			

- Molecule 2 is a protein called Proteasome subunit alpha type-3.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	244	Total	C	N	O	S	0	0	0
			1904	1201	321	379	3			
2	P	244	Total	C	N	O	S	0	0	0
			1904	1201	321	379	3			

- Molecule 3 is a protein called Proteasome subunit alpha type-4.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	C	240	Total	C	N	O	S	0	0	0
			1881	1176	329	372	4			
3	Q	240	Total	C	N	O	S	0	0	0
			1881	1176	329	372	4			

- Molecule 4 is a protein called Proteasome subunit alpha type-5.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
4	D	235	Total	C	N	O	S	0	0	0
			1813	1136	304	366	7			
4	R	235	Total	C	N	O	S	0	0	0
			1813	1136	304	366	7			

- Molecule 5 is a protein called Proteasome subunit alpha type-6.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
5	E	231	Total	C	N	O	S	0	0	0
			1773	1114	307	348	4			
5	S	231	Total	C	N	O	S	0	0	0
			1773	1114	307	348	4			

- Molecule 6 is a protein called proteasome subunit alpha type-7.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
6	F	243	Total	C	N	O	S	0	0	0
			1892	1203	329	356	4			
6	T	243	Total	C	N	O	S	0	0	0
			1892	1203	329	356	4			

- Molecule 7 is a protein called Proteasome subunit alpha type-1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
7	G	241	Total	C	N	O	S	0	0	0
			1907	1214	320	365	8			
7	U	241	Total	C	N	O	S	0	0	0
			1907	1214	320	365	8			

- Molecule 8 is a protein called Proteasome subunit beta type-2.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
8	H	222	Total	C	N	O	S	0	0	0
			1683	1060	291	325	7			
8	V	222	Total	C	N	O	S	0	0	0
			1683	1060	291	325	7			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
H	116	GLU	HIS	engineered mutation	UNP P25043
V	116	GLU	HIS	engineered mutation	UNP P25043

- Molecule 9 is a protein called Proteasome subunit beta type-3.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
9	I	204	Total	C	N	O	S	0	0	0
			1581	1010	258	305	8			
9	W	204	Total	C	N	O	S	0	0	0
			1581	1010	258	305	8			

- Molecule 10 is a protein called Proteasome subunit beta type-4.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
10	J	195	Total	C	N	O	S	0	0	0
			1561	992	264	299	6			
10	X	195	Total	C	N	O	S	0	0	0
			1561	992	264	299	6			

- Molecule 11 is a protein called Proteasome subunit beta type-5.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
11	K	212	Total	C	N	O	S	0	0	0
			1644	1045	280	312	7			
11	Y	212	Total	C	N	O	S	0	0	0
			1644	1045	280	312	7			

- Molecule 12 is a protein called Proteasome subunit beta type-6.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
12	L	222	Total	C	N	O	S	0	0	0
			1757	1115	303	335	4			
12	Z	222	Total	C	N	O	S	0	1	0
			1764	1120	305	335	4			

- Molecule 13 is a protein called Proteasome subunit beta type-7.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
13	M	233	Total	C	N	O	S	0	0	0
			1824	1154	312	351	7			
13	a	233	Total	C	N	O	S	0	0	0
			1824	1154	312	351	7			

- Molecule 14 is a protein called Proteasome subunit beta type-1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
14	N	196	Total	C	N	O	S	0	0	0
			1512	955	250	300	7			
14	b	196	Total	C	N	O	S	0	0	0
			1512	955	250	300	7			

- Molecule 15 is a protein called Ac-LAE-ep.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
15	1	5	Total	C	N	O	0	0	0
			29	19	3	7			
15	2	5	Total	C	N	O	0	0	0
			29	19	3	7			
15	3	5	Total	C	N	O	0	0	0
			29	19	3	7			
15	4	5	Total	C	N	O	0	0	0
			29	19	3	7			
15	5	5	Total	C	N	O	0	0	0
			29	19	3	7			
15	6	5	Total	C	N	O	0	0	0
			29	19	3	7			

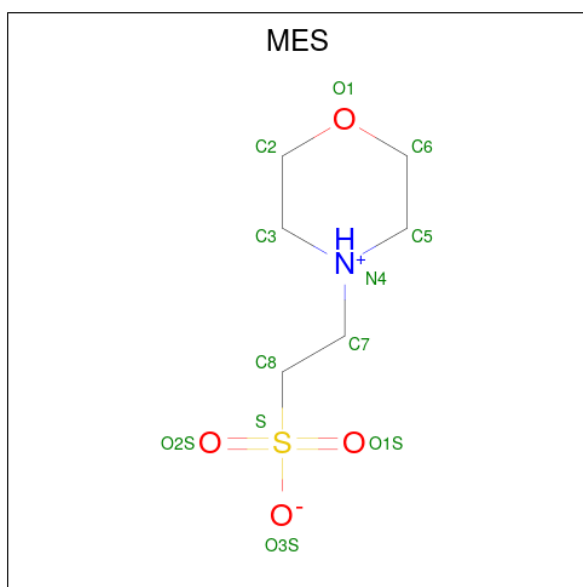
- Molecule 16 is MAGNESIUM ION (CCD ID: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
16	G	1	Total	Mg	0	0
			1	1		
16	H	1	Total	Mg	0	0
			1	1		
16	I	2	Total	Mg	0	0
			2	2		
16	K	1	Total	Mg	0	0
			1	1		
16	L	1	Total	Mg	0	0
			1	1		
16	N	1	Total	Mg	0	0
			1	1		

- Molecule 17 is CHLORIDE ION (CCD ID: CL) (formula: Cl).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
17	G	1	Total	Cl	0	0
			1	1		
17	U	1	Total	Cl	0	0
			1	1		

- Molecule 18 is 2-(N-MORPHOLINO)-ETHANESULFONIC ACID (CCD ID: MES) (formula: C₆H₁₃NO₄S).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
18	H	1	Total	C	N	O	S	0	0
			12	6	1	4	1		
18	K	1	Total	C	N	O	S	0	0
			12	6	1	4	1		
18	V	1	Total	C	N	O	S	0	0
			12	6	1	4	1		
18	Y	1	Total	C	N	O	S	0	0
			12	6	1	4	1		

- Molecule 19 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
19	A	13	Total	O	0	0
			13	13		
19	B	12	Total	O	0	0
			12	12		
19	C	12	Total	O	0	0
			12	12		
19	D	10	Total	O	0	0
			10	10		
19	E	4	Total	O	0	0
			4	4		
19	F	12	Total	O	0	0
			12	12		
19	G	13	Total	O	0	0
			13	13		
19	H	19	Total	O	0	0
			19	19		

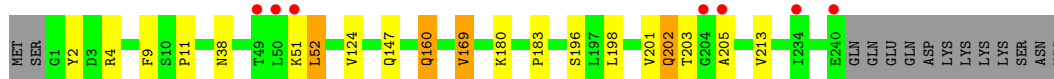
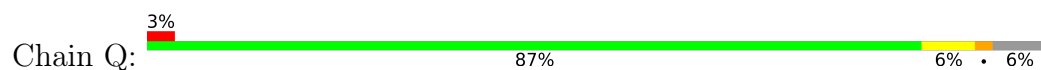
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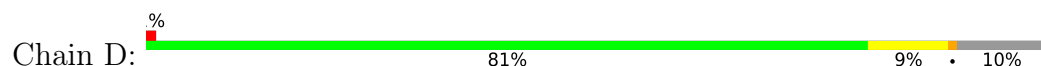
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
19	I	7	Total 7	O 7	0	0
19	J	15	Total 15	O 15	0	0
19	K	12	Total 12	O 12	0	0
19	L	16	Total 16	O 16	0	0
19	M	14	Total 14	O 14	0	0
19	N	9	Total 9	O 9	0	0
19	O	6	Total 6	O 6	0	0
19	P	9	Total 9	O 9	0	0
19	Q	7	Total 7	O 7	0	0
19	R	4	Total 4	O 4	0	0
19	S	5	Total 5	O 5	0	0
19	T	8	Total 8	O 8	0	0
19	U	16	Total 16	O 16	0	0
19	V	12	Total 12	O 12	0	0
19	W	5	Total 5	O 5	0	0
19	X	18	Total 18	O 18	0	0
19	Y	9	Total 9	O 9	0	0
19	Z	15	Total 15	O 15	0	0
19	a	21	Total 21	O 21	0	0
19	b	14	Total 14	O 14	0	0
19	2	1	Total 1	O 1	0	0



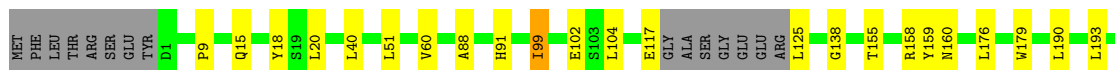
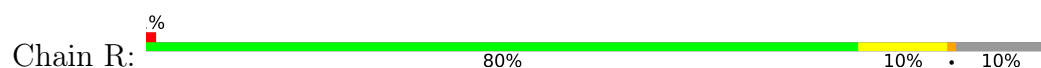
• Molecule 3: Proteasome subunit alpha type-4



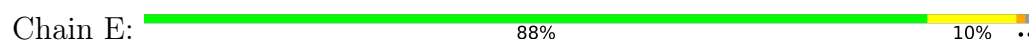
• Molecule 4: Proteasome subunit alpha type-5



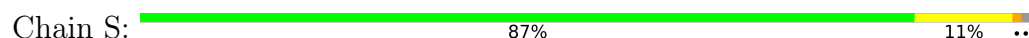
• Molecule 4: Proteasome subunit alpha type-5



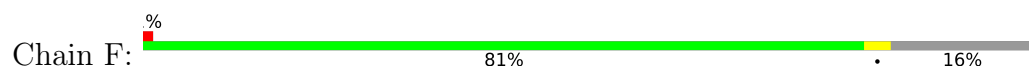
• Molecule 5: Proteasome subunit alpha type-6

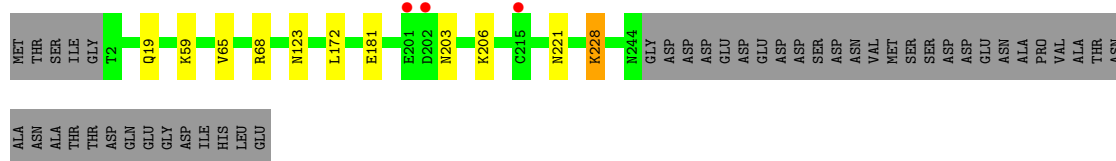


• Molecule 5: Proteasome subunit alpha type-6

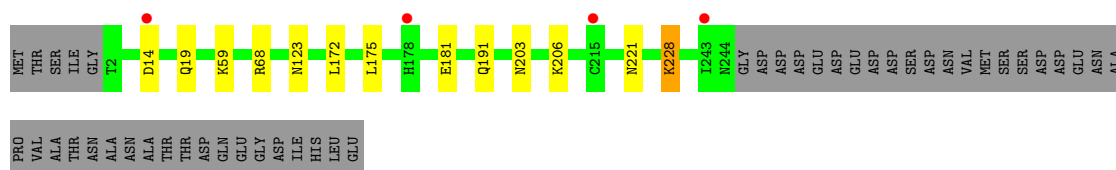
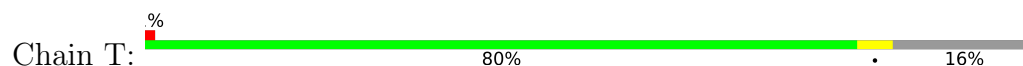


• Molecule 6: proteasome subunit alpha type-7





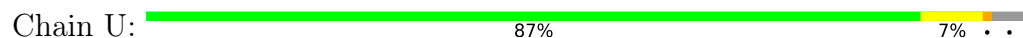
- Molecule 6: proteasome subunit alpha type-7



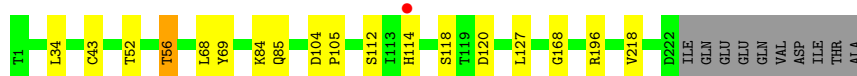
- Molecule 7: Proteasome subunit alpha type-1



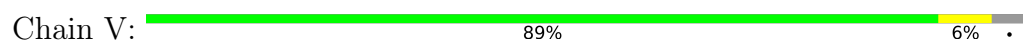
- Molecule 7: Proteasome subunit alpha type-1



- Molecule 8: Proteasome subunit beta type-2



- Molecule 8: Proteasome subunit beta type-2



- Molecule 9: Proteasome subunit beta type-3





- Molecule 9: Proteasome subunit beta type-3

Chain W: 93% 6%



- Molecule 10: Proteasome subunit beta type-4

Chain J: 89% 8% ..



- Molecule 10: Proteasome subunit beta type-4

Chain X: 89% 8% ..



- Molecule 11: Proteasome subunit beta type-5

Chain K: 89% 11%



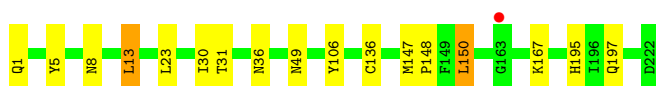
- Molecule 11: Proteasome subunit beta type-5

Chain Y: 89% 10%



- Molecule 12: Proteasome subunit beta type-6

Chain L: 92% 7%



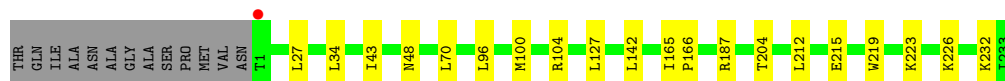
- Molecule 12: Proteasome subunit beta type-6

Chain Z: 91% 8%



- Molecule 13: Proteasome subunit beta type-7

Chain M: 87% 8% 5%



- Molecule 13: Proteasome subunit beta type-7

Chain a: 87% 7% 5%



- Molecule 14: Proteasome subunit beta type-1

Chain N: 94% 6%



- Molecule 14: Proteasome subunit beta type-1

Chain b: 93% 7%



- Molecule 15: Ac-LAE-ep

Chain 1: 40% 40% 20%



- Molecule 15: Ac-LAE-ep

Chain 2: 40% 40% 20%



- Molecule 15: Ac-LAE-ep

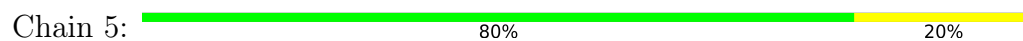
Chain 3: 80% 20%



- Molecule 15: Ac-LAE-ep



- Molecule 15: Ac-LAE-ep



- Molecule 15: Ac-LAE-ep



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	135.35Å 299.22Å 145.14Å 90.00° 113.20° 90.00°	Depositor
Resolution (Å)	15.00 – 2.80 15.00 – 2.80	Depositor EDS
% Data completeness (in resolution range)	96.4 (15.00-2.80) 95.8 (15.00-2.80)	Depositor EDS
R_{merge}	0.08	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.60 (at 2.81Å)	Xtriage
Refinement program	REFMAC 5.7.0032	Depositor
R, R_{free}	0.195 , 0.218 0.196 , 0.218	Depositor DCC
R_{free} test set	12433 reflections (5.00%)	wwPDB-VP
Wilson B-factor (Å ²)	63.0	Xtriage
Anisotropy	0.065	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.30 , 54.3	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.95	EDS
Total number of atoms	49850	wwPDB-VP
Average B, all atoms (Å ²)	70.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.28% 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 [i](#)

5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: CL, GAU, MG, ACE, MES, POL

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	0.38	0/1952	0.69	0/2642
1	O	0.38	0/1952	0.69	0/2642
2	B	0.39	0/1934	0.69	0/2618
2	P	0.39	0/1934	0.69	0/2618
3	C	0.39	0/1910	0.71	0/2586
3	Q	0.39	0/1910	0.71	0/2586
4	D	0.38	0/1837	0.66	0/2475
4	R	0.38	0/1837	0.66	0/2475
5	E	0.38	0/1800	0.67	0/2433
5	S	0.38	0/1800	0.67	0/2433
6	F	0.39	0/1932	0.70	0/2609
6	T	0.39	0/1932	0.70	0/2609
7	G	0.39	0/1945	0.68	0/2634
7	U	0.39	0/1945	0.68	0/2634
8	H	0.38	0/1713	0.68	0/2323
8	V	0.39	0/1713	0.67	0/2323
9	I	0.37	0/1611	0.69	0/2174
9	W	0.38	0/1611	0.69	1/2174 (0.0%)
10	J	0.37	0/1589	0.67	0/2142
10	X	0.37	0/1589	0.67	0/2142
11	K	0.38	0/1681	0.67	0/2274
11	Y	0.37	0/1681	0.67	0/2274
12	L	0.37	0/1795	0.66	0/2420
12	Z	0.45	2/1806 (0.1%)	0.82	6/2435 (0.2%)
13	M	0.41	0/1855	0.67	0/2514
13	a	0.38	0/1855	0.67	0/2514
14	N	0.45	0/1541	0.71	0/2087
14	b	0.44	0/1541	0.70	0/2087
15	1	1.21	0/13	1.15	0/17
15	2	0.95	0/13	0.96	0/17
15	3	1.27	0/13	1.32	0/17
15	4	1.28	0/13	1.12	0/17

Mol	Chain	Bond lengths		Bond angles	
		RMSZ	# Z >5	RMSZ	# Z >5
15	5	0.88	0/13	0.96	0/17
15	6	1.17	0/13	1.31	0/17
All	All	0.39	2/50279 (0.0%)	0.69	7/67979 (0.0%)

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
12	Z	108[A]	HIS	CA-C	7.45	1.61	1.52
12	Z	108[B]	HIS	CA-C	7.45	1.61	1.52

The worst 5 of 7 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
12	Z	108[A]	HIS	CA-C-O	13.23	135.24	120.43
12	Z	108[B]	HIS	CA-C-O	13.23	135.24	120.43
12	Z	108[A]	HIS	CA-C-N	-6.40	113.89	122.72
12	Z	108[A]	HIS	C-N-CA	-6.40	113.89	122.72
12	Z	108[B]	HIS	CA-C-N	-6.40	113.89	122.72

There are no chirality outliers.

There are no planarity outliers.

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	1915	0	1929	7	0
1	O	1915	0	1929	9	0
2	B	1904	0	1904	14	0
2	P	1904	0	1904	12	0
3	C	1881	0	1895	14	0
3	Q	1881	0	1895	11	0
4	D	1813	0	1797	8	0
4	R	1813	0	1797	11	0
5	E	1773	0	1775	9	0
5	S	1773	0	1775	12	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
6	F	1892	0	1883	3	0
6	T	1892	0	1883	3	0
7	G	1907	0	1901	6	0
7	U	1907	0	1901	9	0
8	H	1683	0	1684	8	0
8	V	1683	0	1684	6	0
9	I	1581	0	1574	6	0
9	W	1581	0	1574	5	0
10	J	1561	0	1569	12	0
10	X	1561	0	1569	12	0
11	K	1644	0	1593	13	0
11	Y	1644	0	1592	12	0
12	L	1757	0	1711	6	0
12	Z	1764	0	1718	10	0
13	M	1824	0	1832	6	0
13	a	1824	0	1832	6	0
14	N	1512	0	1478	8	0
14	b	1512	0	1478	14	0
15	1	29	0	30	3	0
15	2	29	0	30	3	0
15	3	29	0	30	7	0
15	4	29	0	30	2	0
15	5	29	0	30	0	0
15	6	29	0	30	10	0
16	G	1	0	0	0	0
16	H	1	0	0	0	0
16	I	2	0	0	0	0
16	K	1	0	0	0	0
16	L	1	0	0	0	0
16	N	1	0	0	0	0
17	G	1	0	0	1	0
17	U	1	0	0	0	0
18	H	12	0	13	0	0
18	K	12	0	13	0	0
18	V	12	0	13	1	0
18	Y	12	0	13	0	0
19	2	1	0	0	0	0
19	A	13	0	0	1	0
19	B	12	0	0	0	0
19	C	12	0	0	0	0
19	D	10	0	0	0	0
19	E	4	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
19	F	12	0	0	1	0
19	G	13	0	0	0	0
19	H	19	0	0	0	0
19	I	7	0	0	0	0
19	J	15	0	0	0	0
19	K	12	0	0	0	0
19	L	16	0	0	0	0
19	M	14	0	0	0	0
19	N	9	0	0	0	0
19	O	6	0	0	0	0
19	P	9	0	0	0	0
19	Q	7	0	0	0	0
19	R	4	0	0	0	0
19	S	5	0	0	0	0
19	T	8	0	0	0	0
19	U	16	0	0	0	0
19	V	12	0	0	0	0
19	W	5	0	0	0	0
19	X	18	0	0	0	0
19	Y	9	0	0	0	0
19	Z	15	0	0	0	0
19	a	21	0	0	0	0
19	b	14	0	0	0	0
All	All	49850	0	49288	225	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 2.

The worst 5 of 225 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)
14:b:22:THR:HG22	15:6:2:LEU:HD23	1.17	1.14
14:b:22:THR:CG2	15:6:2:LEU:HD23	1.88	1.04
14:b:22:THR:CG2	15:6:2:LEU:CD2	2.46	0.93
11:K:100:MET:HE3	11:K:127:PHE:HB2	1.56	0.87
11:Y:100:MET:HE3	11:Y:127:PHE:HB2	1.56	0.85

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	248/250 (99%)	242 (98%)	5 (2%)	1 (0%)	30	60
1	O	248/250 (99%)	242 (98%)	5 (2%)	1 (0%)	30	60
2	B	242/258 (94%)	234 (97%)	7 (3%)	1 (0%)	30	60
2	P	242/258 (94%)	234 (97%)	7 (3%)	1 (0%)	30	60
3	C	238/254 (94%)	228 (96%)	7 (3%)	3 (1%)	9	31
3	Q	238/254 (94%)	228 (96%)	7 (3%)	3 (1%)	9	31
4	D	231/260 (89%)	226 (98%)	5 (2%)	0	100	100
4	R	231/260 (89%)	226 (98%)	5 (2%)	0	100	100
5	E	229/234 (98%)	224 (98%)	5 (2%)	0	100	100
5	S	229/234 (98%)	224 (98%)	5 (2%)	0	100	100
6	F	241/288 (84%)	233 (97%)	8 (3%)	0	100	100
6	T	241/288 (84%)	234 (97%)	7 (3%)	0	100	100
7	G	239/252 (95%)	235 (98%)	4 (2%)	0	100	100
7	U	239/252 (95%)	235 (98%)	4 (2%)	0	100	100
8	H	220/232 (95%)	213 (97%)	7 (3%)	0	100	100
8	V	220/232 (95%)	214 (97%)	6 (3%)	0	100	100
9	I	202/205 (98%)	195 (96%)	7 (4%)	0	100	100
9	W	202/205 (98%)	195 (96%)	7 (4%)	0	100	100
10	J	193/198 (98%)	189 (98%)	3 (2%)	1 (0%)	24	55
10	X	193/198 (98%)	189 (98%)	3 (2%)	1 (0%)	24	55
11	K	210/212 (99%)	206 (98%)	4 (2%)	0	100	100
11	Y	210/212 (99%)	207 (99%)	3 (1%)	0	100	100
12	L	220/222 (99%)	216 (98%)	4 (2%)	0	100	100
12	Z	221/222 (100%)	217 (98%)	4 (2%)	0	100	100
13	M	231/246 (94%)	224 (97%)	7 (3%)	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
13	a	231/246 (94%)	224 (97%)	7 (3%)	0	100	100
14	N	194/196 (99%)	187 (96%)	7 (4%)	0	100	100
14	b	194/196 (99%)	188 (97%)	6 (3%)	0	100	100
15	1	2/5 (40%)	2 (100%)	0	0	100	100
15	2	2/5 (40%)	2 (100%)	0	0	100	100
15	3	2/5 (40%)	2 (100%)	0	0	100	100
15	4	2/5 (40%)	2 (100%)	0	0	100	100
15	5	2/5 (40%)	2 (100%)	0	0	100	100
15	6	2/5 (40%)	2 (100%)	0	0	100	100
All	All	6289/6644 (95%)	6121 (97%)	156 (2%)	12 (0%)	43	72

5 of 12 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
2	B	51	VAL
3	C	202	GLN
10	J	2	ASP
2	P	51	VAL
3	Q	202	GLN

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	209/209 (100%)	202 (97%)	7 (3%)	33	69
1	O	209/209 (100%)	202 (97%)	7 (3%)	33	69
2	B	203/216 (94%)	193 (95%)	10 (5%)	22	55
2	P	203/216 (94%)	193 (95%)	10 (5%)	22	55
3	C	212/226 (94%)	203 (96%)	9 (4%)	26	61
3	Q	212/226 (94%)	203 (96%)	9 (4%)	26	61
4	D	194/215 (90%)	178 (92%)	16 (8%)	10	33

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
4	R	194/215 (90%)	178 (92%)	16 (8%)	10	33
5	E	190/193 (98%)	179 (94%)	11 (6%)	18	49
5	S	190/193 (98%)	179 (94%)	11 (6%)	18	49
6	F	201/239 (84%)	192 (96%)	9 (4%)	24	58
6	T	201/239 (84%)	191 (95%)	10 (5%)	22	54
7	G	206/210 (98%)	195 (95%)	11 (5%)	20	52
7	U	206/210 (98%)	195 (95%)	11 (5%)	20	52
8	H	181/190 (95%)	174 (96%)	7 (4%)	28	64
8	V	181/190 (95%)	174 (96%)	7 (4%)	28	64
9	I	172/173 (99%)	166 (96%)	6 (4%)	32	67
9	W	172/173 (99%)	166 (96%)	6 (4%)	32	67
10	J	173/175 (99%)	168 (97%)	5 (3%)	37	73
10	X	173/175 (99%)	168 (97%)	5 (3%)	37	73
11	K	169/169 (100%)	163 (96%)	6 (4%)	31	66
11	Y	169/169 (100%)	163 (96%)	6 (4%)	31	66
12	L	185/185 (100%)	178 (96%)	7 (4%)	29	64
12	Z	186/185 (100%)	179 (96%)	7 (4%)	29	64
13	M	199/208 (96%)	190 (96%)	9 (4%)	24	58
13	a	199/208 (96%)	190 (96%)	9 (4%)	24	58
14	N	162/162 (100%)	158 (98%)	4 (2%)	42	76
14	b	162/162 (100%)	158 (98%)	4 (2%)	42	76
15	1	1/1 (100%)	1 (100%)	0	100	100
15	2	1/1 (100%)	1 (100%)	0	100	100
15	3	1/1 (100%)	1 (100%)	0	100	100
15	4	1/1 (100%)	1 (100%)	0	100	100
15	5	1/1 (100%)	1 (100%)	0	100	100
15	6	1/1 (100%)	1 (100%)	0	100	100
All	All	5319/5546 (96%)	5084 (96%)	235 (4%)	25	59

5 of 235 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
14	N	119	VAL

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Mol	Chain	Res	Type
12	Z	167	LYS
4	R	20	LEU
12	Z	136	CYS
9	W	37	ASN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 159 such sidechains are listed below:

Mol	Chain	Res	Type
7	U	30	ASN
11	Y	208	ASN
7	U	121	GLN
9	W	63	ASN
12	Z	158	ASN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

6 non-standard protein/DNA/RNA residues are modelled in this entry.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. 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 $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\# Z > 2$	Counts	RMSZ	$\# Z > 2$
15	GAU	3	4	15,14	8,8,8	1.23	1 (12%)	8,9,9	1.80	3 (37%)
15	GAU	2	4	11,15	8,8,8	1.21	1 (12%)	8,9,9	1.40	1 (12%)
15	GAU	5	4	11,15	8,8,8	1.22	1 (12%)	8,9,9	1.08	0
15	GAU	4	4	15,8	8,8,8	1.02	0	8,9,9	1.56	3 (37%)
15	GAU	1	4	15,8	8,8,8	0.96	0	8,9,9	1.38	1 (12%)
15	GAU	6	4	15,14	8,8,8	1.30	1 (12%)	8,9,9	1.54	1 (12%)

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral

centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
15	GAU	3	4	15,14	-	4/7/7/7	-
15	GAU	2	4	11,15	-	1/7/7/7	-
15	GAU	5	4	11,15	-	0/7/7/7	-
15	GAU	4	4	15,8	-	0/7/7/7	-
15	GAU	1	4	15,8	-	0/7/7/7	-
15	GAU	6	4	15,14	-	0/7/7/7	-

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
15	6	4	GAU	OE2-CD	-2.62	1.22	1.30
15	3	4	GAU	OE2-CD	-2.44	1.22	1.30
15	2	4	GAU	OE2-CD	-2.23	1.23	1.30
15	5	4	GAU	OE2-CD	-2.05	1.24	1.30

The worst 5 of 9 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
15	3	4	GAU	CG-CB-CA	-3.24	105.95	112.87
15	3	4	GAU	CB-CA-N	-2.88	100.41	109.16
15	6	4	GAU	CG-CB-CA	-2.46	107.62	112.87
15	4	4	GAU	CB-CA-N	-2.29	102.20	109.16
15	1	4	GAU	CB-CA-N	-2.23	102.39	109.16

There are no chirality outliers.

All (5) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
15	2	4	GAU	O-C-CA-N
15	3	4	GAU	O-C-CA-N
15	3	4	GAU	O-C-CA-CB
15	3	4	GAU	OE2-CD-CG-CB
15	3	4	GAU	OE1-CD-CG-CB

There are no ring outliers.

5 monomers are involved in 9 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
15	3	4	GAU	3	0
15	2	4	GAU	1	0
15	4	4	GAU	1	0
15	1	4	GAU	2	0
15	6	4	GAU	2	0

5.5 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 13 ligands modelled in this entry, 9 are monoatomic - leaving 4 for Mogul analysis.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the Chemical Component Dictionary. The Link column lists molecule types, if any, to which the group is linked. 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 $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\# Z > 2$	Counts	RMSZ	$\# Z > 2$
18	MES	H	302	-	12,12,12	2.18	1 (8%)	15,16,16	1.32	1 (6%)
18	MES	Y	301	-	12,12,12	2.28	1 (8%)	15,16,16	1.10	2 (13%)
18	MES	K	302	-	12,12,12	2.23	1 (8%)	15,16,16	1.20	1 (6%)
18	MES	V	301	-	12,12,12	2.33	1 (8%)	15,16,16	1.06	0

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the Chemical Component Dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
18	MES	H	302	-	-	4/6/14/14	0/1/1/1
18	MES	Y	301	-	-	0/6/14/14	0/1/1/1
18	MES	K	302	-	-	0/6/14/14	0/1/1/1
18	MES	V	301	-	-	3/6/14/14	0/1/1/1

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
18	V	301	MES	C8-S	-7.76	1.66	1.77
18	Y	301	MES	C8-S	-7.58	1.67	1.77
18	K	302	MES	C8-S	-7.41	1.67	1.77
18	H	302	MES	C8-S	-7.20	1.67	1.77

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
18	H	302	MES	O2S-S-C8	3.51	112.03	106.73
18	K	302	MES	O3S-S-C8	2.23	110.38	106.00
18	Y	301	MES	O3S-S-C8	2.21	110.33	106.00
18	Y	301	MES	O2S-S-C8	2.10	109.90	106.73

There are no chirality outliers.

5 of 7 torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
18	V	301	MES	C7-C8-S-O1S
18	V	301	MES	C7-C8-S-O2S
18	H	302	MES	C7-C8-S-O3S
18	V	301	MES	C7-C8-S-O3S
18	H	302	MES	C7-C8-S-O1S

There are no ring outliers.

1 monomer is involved in 1 short contact:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
18	V	301	MES	1	0

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	250/250 (100%)	-0.40	1 (0%) 88 84	46, 59, 95, 134	0
1	O	250/250 (100%)	-0.33	1 (0%) 88 84	50, 67, 109, 139	0
2	B	244/258 (94%)	-0.21	4 (1%) 70 61	48, 66, 113, 169	0
2	P	244/258 (94%)	-0.18	3 (1%) 76 68	53, 70, 117, 172	0
3	C	240/254 (94%)	-0.23	3 (1%) 75 66	47, 68, 132, 170	0
3	Q	240/254 (94%)	-0.00	7 (2%) 53 43	57, 84, 159, 206	0
4	D	235/260 (90%)	-0.34	2 (0%) 81 74	52, 72, 104, 146	0
4	R	235/260 (90%)	-0.16	3 (1%) 75 66	57, 75, 111, 156	0
5	E	231/234 (98%)	-0.23	1 (0%) 88 84	54, 75, 108, 152	0
5	S	231/234 (98%)	-0.07	0 100 100	55, 81, 118, 156	0
6	F	243/288 (84%)	-0.21	3 (1%) 76 68	52, 70, 119, 152	0
6	T	243/288 (84%)	-0.12	4 (1%) 70 61	52, 75, 127, 161	0
7	G	241/252 (95%)	-0.34	0 100 100	45, 61, 102, 153	0
7	U	241/252 (95%)	-0.37	0 100 100	49, 63, 94, 140	0
8	H	222/232 (95%)	-0.39	1 (0%) 87 82	45, 57, 86, 126	1 (0%)
8	V	222/232 (95%)	-0.41	1 (0%) 87 82	42, 60, 88, 133	1 (0%)
9	I	204/205 (99%)	-0.54	0 100 100	44, 58, 86, 109	0
9	W	204/205 (99%)	-0.50	0 100 100	45, 59, 87, 114	0
10	J	195/198 (98%)	-0.49	1 (0%) 87 82	46, 60, 84, 134	0
10	X	195/198 (98%)	-0.47	1 (0%) 87 82	48, 61, 87, 138	0
11	K	212/212 (100%)	-0.46	0 100 100	47, 62, 90, 104	0
11	Y	212/212 (100%)	-0.30	0 100 100	50, 65, 97, 124	0
12	L	222/222 (100%)	-0.46	1 (0%) 87 82	46, 60, 88, 115	0
12	Z	222/222 (100%)	-0.43	1 (0%) 87 82	39, 61, 92, 121	1 (0%)

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Mol	Chain	Analysed	<RSRZ>	#RSRZ>2	OWAB(Å ²)	Q<0.9
13	M	233/246 (94%)	-0.53	1 (0%) 88 84	43, 59, 81, 93	0
13	a	233/246 (94%)	-0.53	1 (0%) 88 84	44, 57, 76, 87	0
14	N	196/196 (100%)	-0.52	0 100 100	43, 54, 80, 108	0
14	b	196/196 (100%)	-0.54	0 100 100	44, 54, 82, 105	0
15	1	2/5 (40%)	0.13	0 100 100	61, 61, 61, 65	0
15	2	2/5 (40%)	0.42	0 100 100	77, 77, 77, 82	0
15	3	2/5 (40%)	-0.71	0 100 100	58, 58, 58, 66	0
15	4	2/5 (40%)	0.59	0 100 100	63, 63, 63, 70	0
15	5	2/5 (40%)	0.20	0 100 100	83, 83, 83, 92	0
15	6	2/5 (40%)	-0.36	0 100 100	61, 61, 61, 70	0
All	All	6348/6644 (95%)	-0.34	40 (0%) 85 80	39, 64, 108, 206	3 (0%)

The worst 5 of 40 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
8	H	114	HIS	5.5
10	X	1	MET	5.3
8	V	114	HIS	4.7
10	J	1	MET	4.4
1	A	1	MET	3.9

6.2 Non-standard residues in protein, DNA, RNA chains ⓘ

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors(Å ²)	Q<0.9
15	GAU	1	4	9/9	0.92	0.11	66,70,78,82	0
15	GAU	2	4	9/9	0.92	0.10	63,74,83,83	0
15	GAU	6	4	9/9	0.92	0.11	59,67,69,71	0
15	GAU	4	4	9/9	0.93	0.11	68,70,79,80	0
15	GAU	5	4	9/9	0.94	0.10	77,88,93,95	0
15	GAU	3	4	9/9	0.96	0.07	59,63,69,69	0

6.3 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

6.4 Ligands [i](#)

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. The B-factors column lists the minimum, median, 95th percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	B-factors($\text{\AA}^2$)	Q<0.9
16	MG	H	301	1/1	0.74	0.25	64,64,64,64	0
18	MES	V	301	12/12	0.79	0.22	81,123,146,146	0
18	MES	H	302	12/12	0.84	0.21	77,110,126,129	0
18	MES	K	302	12/12	0.87	0.15	88,97,101,103	0
18	MES	Y	301	12/12	0.90	0.13	89,96,98,98	0
16	MG	I	301	1/1	0.95	0.18	70,70,70,70	0
16	MG	N	201	1/1	0.96	0.07	56,56,56,56	0
16	MG	G	301	1/1	0.96	0.05	64,64,64,64	0
16	MG	I	302	1/1	0.96	0.04	63,63,63,63	0
16	MG	K	301	1/1	0.96	0.07	77,77,77,77	0
16	MG	L	301	1/1	0.96	0.09	64,64,64,64	0
17	CL	G	302	1/1	0.97	0.24	30,30,30,30	0
17	CL	U	301	1/1	0.97	0.19	30,30,30,30	0

6.5 Other polymers [i](#)

There are no such residues in this entry.