



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 6, 2026 – 12:01 PM UTC

PDB ID : 5JQL / pdb_00005jql
Title : Crystal Structure of Phosphatidic acid Transporter Ups1/Mdm35 Void of Bound Phospholipid from *Saccharomyces Cerevisiae* at 2.9 Angstroms Resolution
Authors : Lu, J.; Chan, K.C.; Zhai, Y.; Fan, J.; Sun, F.
Deposited on : 2016-05-05
Resolution : 2.90 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

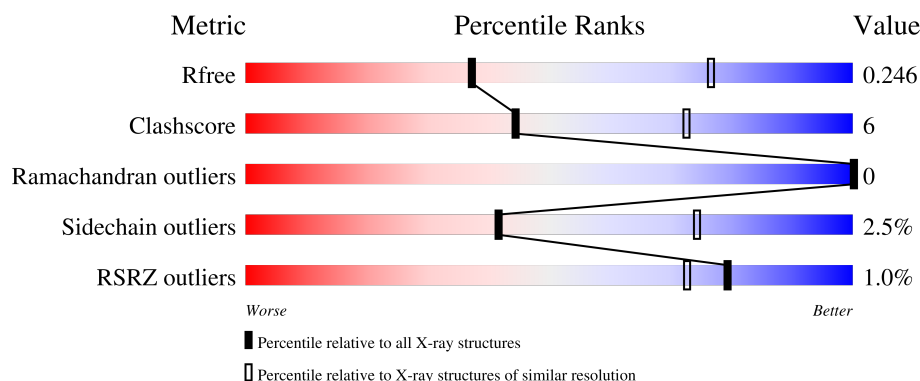
1 Overall quality at a glance ⓘ

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.90 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	2481 (2.90-2.90)
Clashscore	190562	2690 (2.90-2.90)
Ramachandran outliers	187476	2623 (2.90-2.90)
Sidechain outliers	187428	2625 (2.90-2.90)
RSRZ outliers	180081	2481 (2.90-2.90)

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	189	2% 77% 12% 10%
1	E	189	66% 20% 12%
1	I	189	73% 11% 15%
1	K	189	71% 15% 13%
2	B	86	2% 77% 6% 16%

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Mol	Chain	Length	Quality of chain
2	D	86	79%7%14%
2	F	86	76%8%16%
2	J	86	% 67%15%17%
2	L	86	% 69%14%17%
3	C	189	% 78%12%10%
4	G	189	% 75%14%11%
5	H	86	2% 76%7%17%

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 11018 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 Protein UPS1, mitochondrial.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
1	A	171	Total	C	N	O	S	Se	0	0	0
			1278	814	218	241	1	4			
1	E	166	Total	C	N	O	S	Se	0	0	0
			1272	807	222	238	1	4			
1	I	160	Total	C	N	O	S	Se	0	0	0
			1229	779	218	227	1	4			
1	K	164	Total	C	N	O	S	Se	0	0	0
			1262	807	215	235	1	4			

There are 56 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-13	MET	-	expression tag	UNP Q05776
A	-12	GLY	-	expression tag	UNP Q05776
A	-11	SER	-	expression tag	UNP Q05776
A	-10	SER	-	expression tag	UNP Q05776
A	-9	HIS	-	expression tag	UNP Q05776
A	-8	HIS	-	expression tag	UNP Q05776
A	-7	HIS	-	expression tag	UNP Q05776
A	-6	HIS	-	expression tag	UNP Q05776
A	-5	HIS	-	expression tag	UNP Q05776
A	-4	HIS	-	expression tag	UNP Q05776
A	-3	SER	-	expression tag	UNP Q05776
A	-2	GLN	-	expression tag	UNP Q05776
A	-1	ASP	-	expression tag	UNP Q05776
A	0	PRO	-	expression tag	UNP Q05776
E	-13	MET	-	expression tag	UNP Q05776
E	-12	GLY	-	expression tag	UNP Q05776
E	-11	SER	-	expression tag	UNP Q05776
E	-10	SER	-	expression tag	UNP Q05776
E	-9	HIS	-	expression tag	UNP Q05776
E	-8	HIS	-	expression tag	UNP Q05776
E	-7	HIS	-	expression tag	UNP Q05776

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Chain	Residue	Modelled	Actual	Comment	Reference
E	-6	HIS	-	expression tag	UNP Q05776
E	-5	HIS	-	expression tag	UNP Q05776
E	-4	HIS	-	expression tag	UNP Q05776
E	-3	SER	-	expression tag	UNP Q05776
E	-2	GLN	-	expression tag	UNP Q05776
E	-1	ASP	-	expression tag	UNP Q05776
E	0	PRO	-	expression tag	UNP Q05776
I	-13	MET	-	expression tag	UNP Q05776
I	-12	GLY	-	expression tag	UNP Q05776
I	-11	SER	-	expression tag	UNP Q05776
I	-10	SER	-	expression tag	UNP Q05776
I	-9	HIS	-	expression tag	UNP Q05776
I	-8	HIS	-	expression tag	UNP Q05776
I	-7	HIS	-	expression tag	UNP Q05776
I	-6	HIS	-	expression tag	UNP Q05776
I	-5	HIS	-	expression tag	UNP Q05776
I	-4	HIS	-	expression tag	UNP Q05776
I	-3	SER	-	expression tag	UNP Q05776
I	-2	GLN	-	expression tag	UNP Q05776
I	-1	ASP	-	expression tag	UNP Q05776
I	0	PRO	-	expression tag	UNP Q05776
K	-13	MET	-	expression tag	UNP Q05776
K	-12	GLY	-	expression tag	UNP Q05776
K	-11	SER	-	expression tag	UNP Q05776
K	-10	SER	-	expression tag	UNP Q05776
K	-9	HIS	-	expression tag	UNP Q05776
K	-8	HIS	-	expression tag	UNP Q05776
K	-7	HIS	-	expression tag	UNP Q05776
K	-6	HIS	-	expression tag	UNP Q05776
K	-5	HIS	-	expression tag	UNP Q05776
K	-4	HIS	-	expression tag	UNP Q05776
K	-3	SER	-	expression tag	UNP Q05776
K	-2	GLN	-	expression tag	UNP Q05776
K	-1	ASP	-	expression tag	UNP Q05776
K	0	PRO	-	expression tag	UNP Q05776

- Molecule 2 is a protein called Mitochondrial distribution and morphology protein 35.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	72	Total	C	N	O	S	0	0	0
			529	343	85	96	5			
2	D	74	Total	C	N	O	S	0	0	0
			577	367	93	112	5			

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Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	F	72	Total	C	N	O	S	0	0	0
			568	360	90	113	5			
2	J	71	Total	C	N	O	S	0	0	0
			535	342	86	103	4			
2	L	71	Total	C	N	O	S	0	0	0
			553	354	88	106	5			

- Molecule 3 is a protein called Protein UPS1, mitochondrial.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	C	171	Total	C	N	O	Se	0	0	0
			1328	842	232	249	5			

There are 15 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
C	-13	MET	-	expression tag	UNP Q05776
C	-12	GLY	-	expression tag	UNP Q05776
C	-11	SER	-	expression tag	UNP Q05776
C	-10	SER	-	expression tag	UNP Q05776
C	-9	HIS	-	expression tag	UNP Q05776
C	-8	HIS	-	expression tag	UNP Q05776
C	-7	HIS	-	expression tag	UNP Q05776
C	-6	HIS	-	expression tag	UNP Q05776
C	-5	HIS	-	expression tag	UNP Q05776
C	-4	HIS	-	expression tag	UNP Q05776
C	-3	SER	-	expression tag	UNP Q05776
C	-2	GLN	-	expression tag	UNP Q05776
C	-1	ASP	-	expression tag	UNP Q05776
C	0	PRO	-	expression tag	UNP Q05776
C	1	MSE	-	expression tag	UNP Q05776

- Molecule 4 is a protein called Protein UPS1, mitochondrial.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
4	G	169	Total	C	N	O	Se	0	0	0
			1327	842	229	251	5			

There are 15 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
G	-13	MET	-	expression tag	UNP Q05776

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Chain	Residue	Modelled	Actual	Comment	Reference
G	-12	GLY	-	expression tag	UNP Q05776
G	-11	SER	-	expression tag	UNP Q05776
G	-10	SER	-	expression tag	UNP Q05776
G	-9	HIS	-	expression tag	UNP Q05776
G	-8	HIS	-	expression tag	UNP Q05776
G	-7	HIS	-	expression tag	UNP Q05776
G	-6	HIS	-	expression tag	UNP Q05776
G	-5	HIS	-	expression tag	UNP Q05776
G	-4	HIS	-	expression tag	UNP Q05776
G	-3	SER	-	expression tag	UNP Q05776
G	-2	GLN	-	expression tag	UNP Q05776
G	-1	ASP	-	expression tag	UNP Q05776
G	0	PRO	-	expression tag	UNP Q05776
G	1	MSE	-	expression tag	UNP Q05776

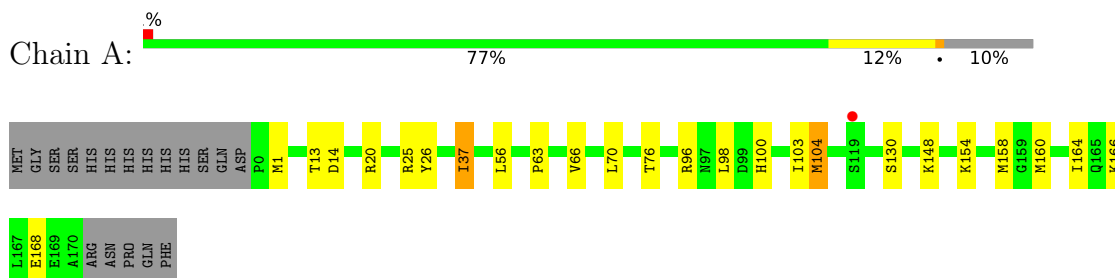
- Molecule 5 is a protein called Mitochondrial distribution and morphology protein 35.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
5	H	71	Total	C	N	O	S	Se	0	0	0
			560	357	89	109	4	1			

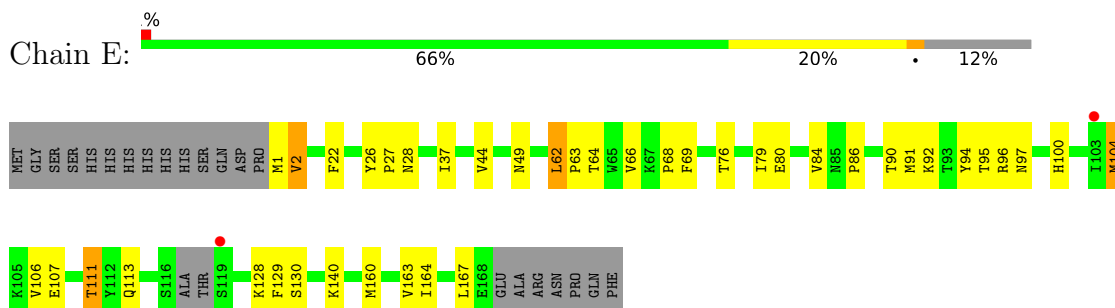
3 Residue-property plots [i](#)

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.

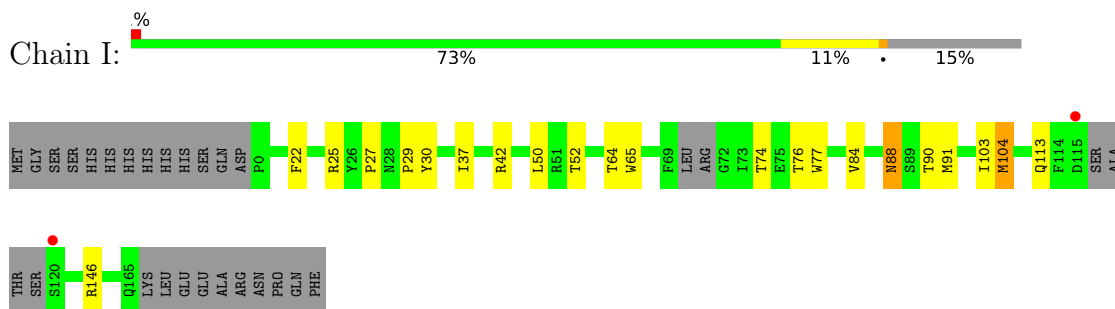
- Molecule 1: Protein UPS1, mitochondrial



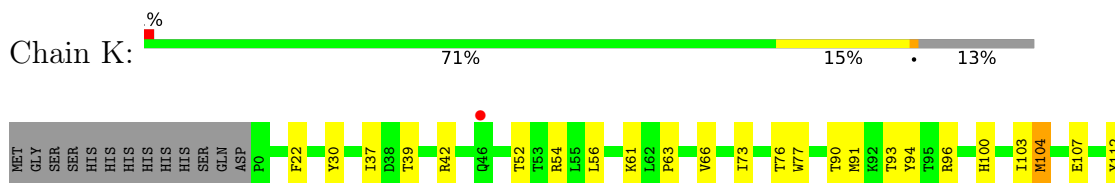
- Molecule 1: Protein UPS1, mitochondrial



- Molecule 1: Protein UPS1, mitochondrial

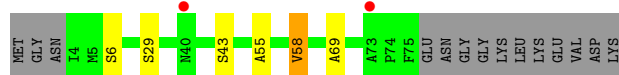
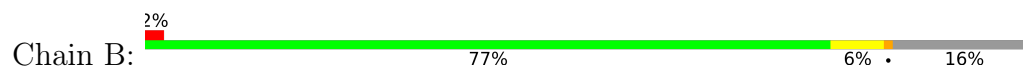


- Molecule 1: Protein UPS1, mitochondrial

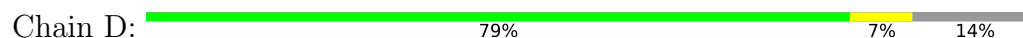




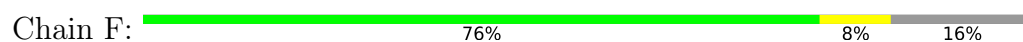
- Molecule 2: Mitochondrial distribution and morphology protein 35



- Molecule 2: Mitochondrial distribution and morphology protein 35



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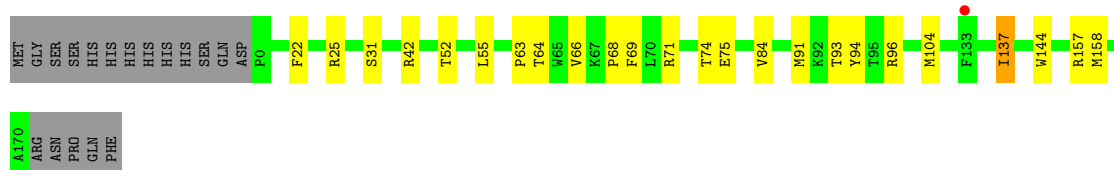
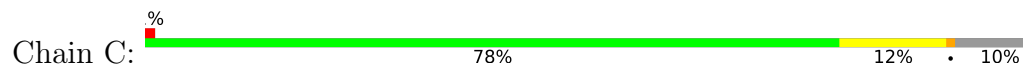
- Molecule 2: Mitochondrial distribution and morphology protein 35



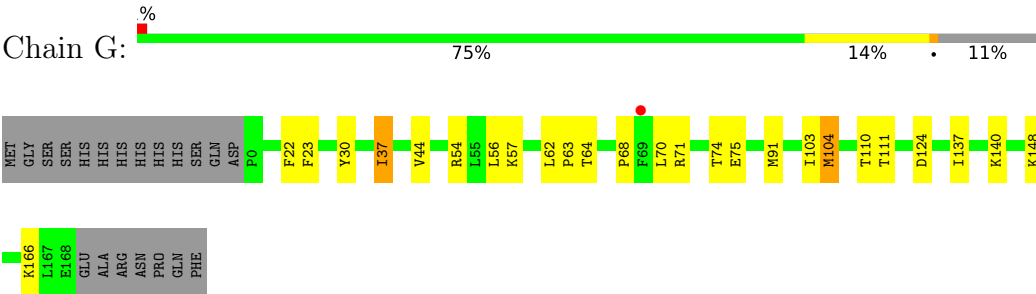
- Molecule 2: Mitochondrial distribution and morphology protein 35



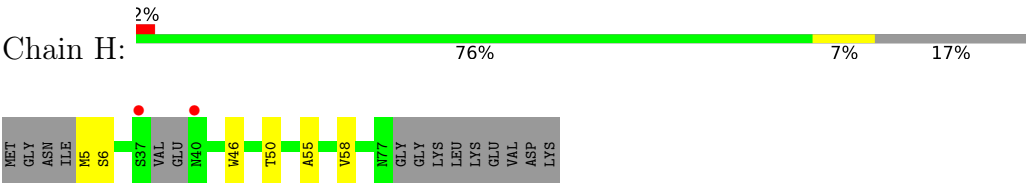
- Molecule 3: Protein UPS1, mitochondrial



● Molecule 4: Protein UPS1, mitochondrial



● Molecule 5: Mitochondrial distribution and morphology protein 35



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	83.31Å 130.74Å 84.27Å 90.00° 103.09° 90.00°	Depositor
Resolution (Å)	48.40 – 2.90 48.40 – 2.90	Depositor EDS
% Data completeness (in resolution range)	97.3 (48.40-2.90) 95.4 (48.40-2.90)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.98 (at 2.86Å)	Xtriage
Refinement program	PHENIX 1.8_1069	Depositor
R, R_{free}	0.200 , 0.248 0.200 , 0.246	Depositor DCC
R_{free} test set	1962 reflections (4.88%)	wwPDB-VP
Wilson B-factor (Å ²)	68.4	Xtriage
Anisotropy	0.060	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.29 , 30.7	EDS
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	0.049 for l,-k,h	Xtriage
F_o, F_c correlation	0.93	EDS
Total number of atoms	11018	wwPDB-VP
Average B, all atoms (Å ²)	38.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.33% 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](#)

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	0.64	0/1303	0.96	1/1770 (0.1%)
1	E	0.60	0/1295	1.03	4/1753 (0.2%)
1	I	0.64	0/1253	0.98	1/1694 (0.1%)
1	K	0.59	0/1288	0.89	0/1744
2	B	0.72	0/543	0.96	0/738
2	D	0.72	0/591	0.98	2/799 (0.3%)
2	F	0.54	0/582	0.92	2/785 (0.3%)
2	J	0.67	0/549	1.06	3/746 (0.4%)
2	L	0.58	0/567	1.00	4/768 (0.5%)
3	C	0.70	0/1353	0.98	2/1828 (0.1%)
4	G	0.72	1/1351 (0.1%)	0.95	0/1822
5	H	0.72	0/573	0.94	0/772
All	All	0.65	1/11248 (0.0%)	0.97	19/15219 (0.1%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	G	44	VAL	CA-CB	-5.92	1.47	1.54

The worst 5 of 19 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	J	10	ALA	CA-C-N	6.87	127.15	119.32
2	J	10	ALA	C-N-CA	6.87	127.15	119.32
2	D	10	ALA	CA-C-N	6.60	126.84	119.32
2	D	10	ALA	C-N-CA	6.60	126.84	119.32
1	E	28	ASN	CA-C-N	6.19	125.87	119.56

There are no chirality outliers.

There are no planarity outliers.

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	1278	0	1201	19	0
1	E	1272	0	1218	24	0
1	I	1229	0	1155	14	0
1	K	1262	0	1209	21	0
2	B	529	0	482	3	0
2	D	577	0	536	3	0
2	F	568	0	522	5	0
2	J	535	0	478	8	0
2	L	553	0	509	11	0
3	C	1328	0	1289	18	0
4	G	1327	0	1308	22	0
5	H	560	0	519	2	0
All	All	11018	0	10426	129	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 6.

The worst 5 of 129 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:76:THR:HG22	1:K:100:HIS:HD2	1.33	0.93
1:K:76:THR:HG22	1:K:100:HIS:CD2	2.12	0.84
3:C:68:PRO:HA	3:C:71:ARG:HG3	1.64	0.77
1:E:68:PRO:HG2	4:G:68:PRO:HG2	1.65	0.76
3:C:64:THR:O	3:C:71:ARG:NH1	2.19	0.75

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	169/189 (89%)	166 (98%)	3 (2%)	0	100	100
1	E	162/189 (86%)	162 (100%)	0	0	100	100
1	I	154/189 (82%)	152 (99%)	2 (1%)	0	100	100
1	K	160/189 (85%)	158 (99%)	2 (1%)	0	100	100
2	B	70/86 (81%)	67 (96%)	3 (4%)	0	100	100
2	D	72/86 (84%)	71 (99%)	1 (1%)	0	100	100
2	F	70/86 (81%)	68 (97%)	2 (3%)	0	100	100
2	J	69/86 (80%)	66 (96%)	3 (4%)	0	100	100
2	L	69/86 (80%)	67 (97%)	2 (3%)	0	100	100
3	C	169/189 (89%)	166 (98%)	3 (2%)	0	100	100
4	G	167/189 (88%)	165 (99%)	2 (1%)	0	100	100
5	H	67/86 (78%)	66 (98%)	1 (2%)	0	100	100
All	All	1398/1650 (85%)	1374 (98%)	24 (2%)	0	100	100

There are no Ramachandran outliers to report.

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	131/170 (77%)	129 (98%)	2 (2%)	57	84
1	E	135/170 (79%)	129 (96%)	6 (4%)	25	59
1	I	127/170 (75%)	122 (96%)	5 (4%)	28	63
1	K	135/170 (79%)	132 (98%)	3 (2%)	45	77
2	B	50/73 (68%)	47 (94%)	3 (6%)	17	47
2	D	60/73 (82%)	60 (100%)	0	100	100
2	F	59/73 (81%)	59 (100%)	0	100	100

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
2	J	52/73 (71%)	50 (96%)	2 (4%)	29	64
2	L	56/73 (77%)	56 (100%)	0	100	100
3	C	143/169 (85%)	141 (99%)	2 (1%)	59	85
4	G	148/168 (88%)	144 (97%)	4 (3%)	39	73
5	H	58/72 (81%)	56 (97%)	2 (3%)	32	66
All	All	1154/1454 (79%)	1125 (98%)	29 (2%)	42	74

5 of 29 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
4	G	57	LYS
1	K	146	ARG
5	H	5	MSE
2	J	53	VAL
4	G	111	THR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 10 such sidechains are listed below:

Mol	Chain	Res	Type
1	K	24	ASN
1	K	100	HIS
2	L	25	ASN
1	E	100	HIS
4	G	49	ASN

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 ⓘ

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	167/189 (88%)	-0.53	1 (0%) 85 81	5, 32, 78, 146	0
1	E	162/189 (85%)	-0.31	2 (1%) 76 69	4, 46, 90, 163	0
1	I	156/189 (82%)	-0.37	2 (1%) 75 67	8, 40, 79, 118	0
1	K	160/189 (84%)	-0.33	1 (0%) 85 81	2, 41, 70, 111	0
2	B	72/86 (83%)	-0.33	2 (2%) 55 46	7, 31, 70, 144	0
2	D	74/86 (86%)	-0.66	0 100 100	7, 29, 59, 82	0
2	F	72/86 (83%)	-0.33	0 100 100	24, 52, 82, 96	0
2	J	71/86 (82%)	-0.21	1 (1%) 73 65	15, 44, 86, 122	0
2	L	71/86 (82%)	-0.36	1 (1%) 73 65	23, 47, 76, 136	0
3	C	166/189 (87%)	-0.52	1 (0%) 85 81	2, 23, 63, 101	0
4	G	163/189 (86%)	-0.61	1 (0%) 85 81	2, 24, 53, 100	0
5	H	70/86 (81%)	-0.65	2 (2%) 53 45	4, 23, 59, 69	0
All	All	1404/1650 (85%)	-0.44	14 (0%) 79 73	2, 35, 78, 163	0

The worst 5 of 14 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	I	115	ASP	5.3
2	B	73	ALA	4.7
2	J	40	ASN	4.6
1	A	119	SER	3.6
1	I	120	SER	3.4

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

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.