



wwPDB EM Validation Summary Report ⓘ

Dec 28, 2025 – 12:24 AM JST

PDB ID : 9J79 / pdb_00009j79
EMDB ID : EMD-61198
Title : Cryo-EM structure of CRL2-FEM1B bound with TOM20(tetramer)
Authors : Zhao, S.; Xu, C.
Deposited on : 2024-08-18
Resolution : 4.08 Å(reported)

This is a wwPDB EM 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/EMValidationReportHelp>

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:

EMDB validation analysis : **FAILED**
MolProbity : 4-5-2 with Phenix2.0
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)
EM percentile statistics : **NOT EXECUTED**
MapQ : **FAILED**
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.47

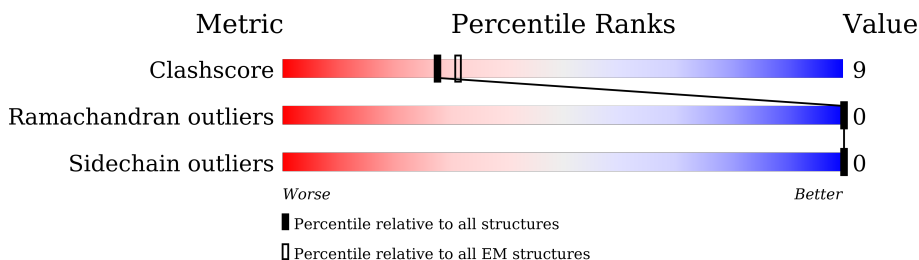
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

ELECTRON MICROSCOPY

The reported resolution of this entry is 4.08 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.



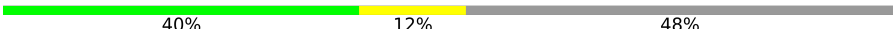
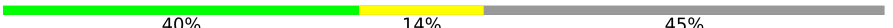
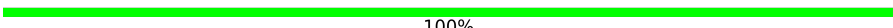
Metric	Whole archive (#Entries)	EM structures (#Entries)
Clashscore	210492	15764
Ramachandran outliers	207382	16835
Sidechain outliers	206894	16415

The table below summarises the geometric issues observed across the polymeric chains and their fit to the map. The red, orange, yellow and green segments of the 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 $\leq 5\%$.

Mol	Chain	Length	Quality of chain
1	E	750	77% 19% .
1	K	750	77% 20% .
2	F	96	83% 17%
2	L	96	82% 18%
3	H	121	58% 21% 21%
3	M	121	55% 24% 21%
4	I	96	50% 24% 26%
4	N	96	61% 28% 10%
5	A	627	76% 24%

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Mol	Chain	Length	Quality of chain
5	J	627	 74%26%
5	O	627	 67%28%6%
5	P	627	 69%21%10%
6	B	121	 40%12%48%
6	C	121	 50%50%
6	G	121	 40%14%45%
6	S	121	 48%50%
7	D	10	 70%30%
7	R	10	 100%
8	Q	8	 88%12%

2 Entry composition

There are 9 unique types of molecules in this entry. The entry contains 36721 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 Cullin-2.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	E	726	Total	C	N	O	S	0	0
			5953	3783	1011	1115	44		
1	K	725	Total	C	N	O	S	0	0
			5947	3781	1009	1113	44		

There are 72 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
E	-19	SER	-	expression tag	UNP Q13617
E	-18	ALA	-	expression tag	UNP Q13617
E	-17	SER	-	expression tag	UNP Q13617
E	-16	TRP	-	expression tag	UNP Q13617
E	-15	SER	-	expression tag	UNP Q13617
E	-14	HIS	-	expression tag	UNP Q13617
E	-13	PRO	-	expression tag	UNP Q13617
E	-12	GLN	-	expression tag	UNP Q13617
E	-11	PHE	-	expression tag	UNP Q13617
E	-10	GLU	-	expression tag	UNP Q13617
E	-9	LYS	-	expression tag	UNP Q13617
E	-8	GLY	-	expression tag	UNP Q13617
E	-7	GLY	-	expression tag	UNP Q13617
E	-6	GLY	-	expression tag	UNP Q13617
E	-5	SER	-	expression tag	UNP Q13617
E	-4	GLY	-	expression tag	UNP Q13617
E	-3	GLY	-	expression tag	UNP Q13617
E	-2	GLY	-	expression tag	UNP Q13617
E	-1	SER	-	expression tag	UNP Q13617
E	0	GLY	-	expression tag	UNP Q13617
E	1	THR	-	expression tag	UNP Q13617
E	?	-	LYS	deletion	UNP Q13617
E	?	-	LEU	deletion	UNP Q13617
E	?	-	THR	deletion	UNP Q13617
E	?	-	GLU	deletion	UNP Q13617
E	?	-	ALA	deletion	UNP Q13617

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Chain	Residue	Modelled	Actual	Comment	Reference
E	?	-	ASP	deletion	UNP Q13617
E	?	-	LEU	deletion	UNP Q13617
E	?	-	GLN	deletion	UNP Q13617
E	?	-	TYR	deletion	UNP Q13617
E	?	-	TYR	deletion	UNP Q13617
E	?	-	VAL	deletion	UNP Q13617
E	?	-	ASP	deletion	UNP Q13617
E	?	-	MET	deletion	UNP Q13617
E	?	-	ASN	deletion	UNP Q13617
E	?	-	GLU	deletion	UNP Q13617
K	-19	SER	-	expression tag	UNP Q13617
K	-18	ALA	-	expression tag	UNP Q13617
K	-17	SER	-	expression tag	UNP Q13617
K	-16	TRP	-	expression tag	UNP Q13617
K	-15	SER	-	expression tag	UNP Q13617
K	-14	HIS	-	expression tag	UNP Q13617
K	-13	PRO	-	expression tag	UNP Q13617
K	-12	GLN	-	expression tag	UNP Q13617
K	-11	PHE	-	expression tag	UNP Q13617
K	-10	GLU	-	expression tag	UNP Q13617
K	-9	LYS	-	expression tag	UNP Q13617
K	-8	GLY	-	expression tag	UNP Q13617
K	-7	GLY	-	expression tag	UNP Q13617
K	-6	GLY	-	expression tag	UNP Q13617
K	-5	SER	-	expression tag	UNP Q13617
K	-4	GLY	-	expression tag	UNP Q13617
K	-3	GLY	-	expression tag	UNP Q13617
K	-2	GLY	-	expression tag	UNP Q13617
K	-1	SER	-	expression tag	UNP Q13617
K	0	GLY	-	expression tag	UNP Q13617
K	1	THR	-	expression tag	UNP Q13617
K	?	-	LYS	deletion	UNP Q13617
K	?	-	LEU	deletion	UNP Q13617
K	?	-	THR	deletion	UNP Q13617
K	?	-	GLU	deletion	UNP Q13617
K	?	-	ALA	deletion	UNP Q13617
K	?	-	ASP	deletion	UNP Q13617
K	?	-	LEU	deletion	UNP Q13617
K	?	-	GLN	deletion	UNP Q13617
K	?	-	TYR	deletion	UNP Q13617
K	?	-	TYR	deletion	UNP Q13617
K	?	-	VAL	deletion	UNP Q13617

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Chain	Residue	Modelled	Actual	Comment	Reference
K	?	-	ASP	deletion	UNP Q13617
K	?	-	MET	deletion	UNP Q13617
K	?	-	ASN	deletion	UNP Q13617
K	?	-	GLU	deletion	UNP Q13617

- Molecule 2 is a protein called Elongin-C.

Mol	Chain	Residues	Atoms					AltConf	Trace
2	F	96	Total	C	N	O	S	0	0
			760	487	122	145	6		
2	L	96	Total	C	N	O	S	0	0
			760	487	122	145	6		

- Molecule 3 is a protein called Elongin-B.

Mol	Chain	Residues	Atoms					AltConf	Trace
3	H	96	Total	C	N	O	S	0	0
			759	483	129	144	3		
3	M	96	Total	C	N	O	S	0	0
			759	483	129	144	3		

There are 6 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
H	-2	GLY	-	expression tag	UNP Q15370
H	-1	GLY	-	expression tag	UNP Q15370
H	0	SER	-	expression tag	UNP Q15370
M	-2	GLY	-	expression tag	UNP Q15370
M	-1	GLY	-	expression tag	UNP Q15370
M	0	SER	-	expression tag	UNP Q15370

- Molecule 4 is a protein called E3 ubiquitin-protein ligase RBX1, N-terminally processed.

Mol	Chain	Residues	Atoms					AltConf	Trace
4	I	71	Total	C	N	O	S	0	0
			585	376	106	94	9		
4	N	86	Total	C	N	O	S	0	0
			703	445	128	121	9		

There are 6 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
I	13	SER	-	expression tag	UNP P62877
I	14	HIS	-	expression tag	UNP P62877
I	15	MET	-	expression tag	UNP P62877
N	13	SER	-	expression tag	UNP P62877
N	14	HIS	-	expression tag	UNP P62877
N	15	MET	-	expression tag	UNP P62877

- Molecule 5 is a protein called Protein fem-1 homolog B.

Mol	Chain	Residues	Atoms					AltConf	Trace
5	J	627	Total	C	N	O	S	0	0
			4932	3092	882	929	29		
5	A	627	Total	C	N	O	S	0	0
			4932	3092	882	929	29		
5	O	592	Total	C	N	O	S	0	0
			4562	2858	820	859	25		
5	P	562	Total	C	N	O	S	0	0
			4314	2701	778	810	25		

- Molecule 6 is a protein called Mitochondrial import receptor subunit TOM20 homolog.

Mol	Chain	Residues	Atoms					AltConf	Trace
6	B	63	Total	C	N	O	S	0	0
			495	322	79	92	2		
6	G	66	Total	C	N	O	S	0	0
			517	334	82	99	2		
6	S	60	Total	C	N	O		0	0
			296	176	60	60			
6	C	61	Total	C	N	O		0	0
			301	179	61	61			

- Molecule 7 is a protein called Poly-UNK.

Mol	Chain	Residues	Atoms				AltConf	Trace
7	D	10	Total	C	N	O	0	0
			50	30	10	10		
7	R	10	Total	C	N	O	0	0
			50	30	10	10		

- Molecule 8 is a protein called Poly-UNK.

Mol	Chain	Residues	Atoms				AltConf	Trace
8	Q	8	Total	C	N	O	0	0
			40	24	8	8		

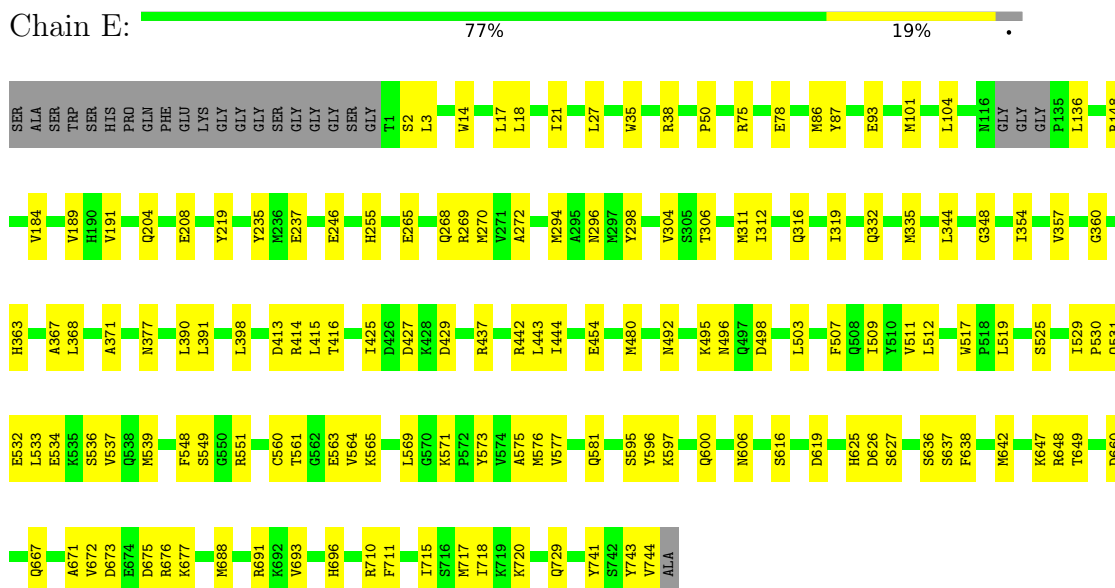
- Molecule 9 is ZINC ION (CCD ID: ZN) (formula: Zn) (labeled as "Ligand of Interest" by depositor).

Mol	Chain	Residues	Atoms		AltConf
9	I	3	Total	Zn	0
			3	3	
9	N	3	Total	Zn	0
			3	3	

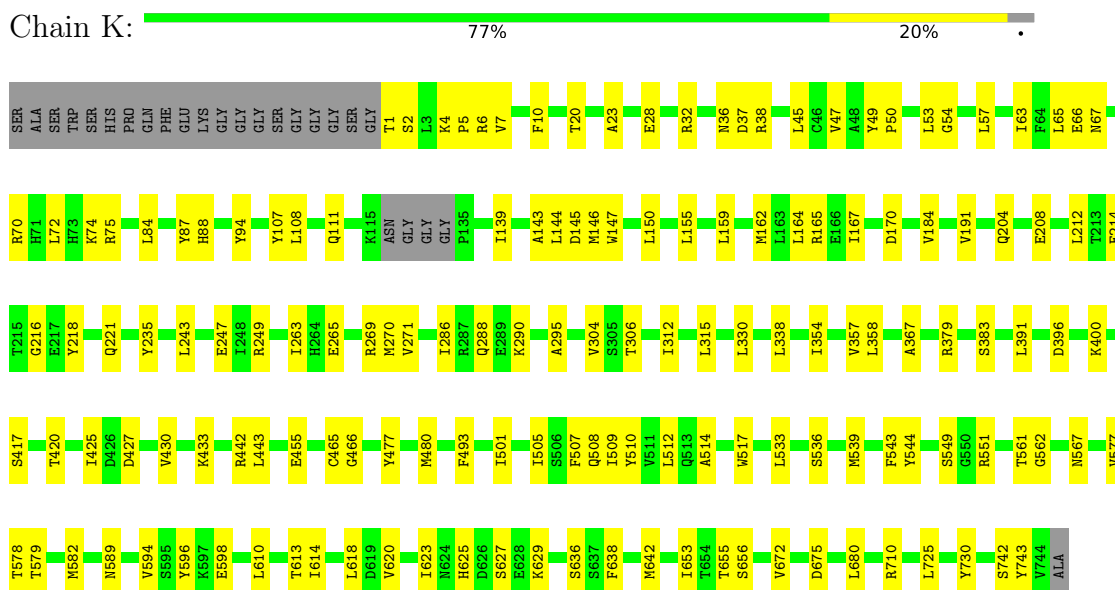
3 Residue-property plots

These plots are drawn for all protein, RNA, DNA and oligosaccharide chains in the entry. The first graphic for a chain summarises the proportions of the various outlier classes displayed in the second graphic. The second graphic shows the sequence view annotated by issues in geometry. 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: Cullin-2



- Molecule 1: Cullin-2



- Molecule 2: Elongin-C

Chain F:  83% 17%



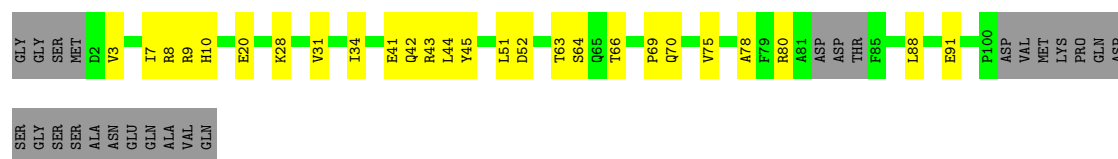
- Molecule 2: Elongin-C

Chain L:  82% 18%



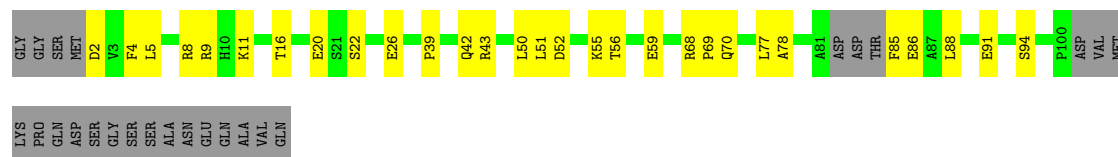
- Molecule 3: Elongin-B

Chain H:  58% 21% 21%



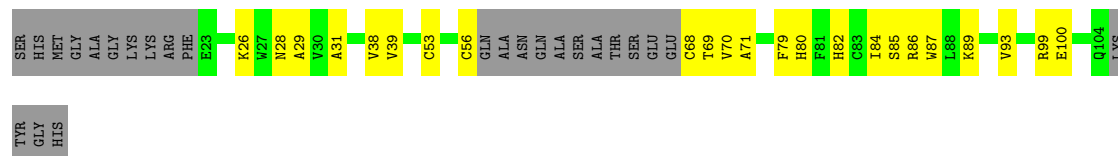
- Molecule 3: Elongin-B

Chain M:  55% 24% 21%



- Molecule 4: E3 ubiquitin-protein ligase RBX1, N-terminally processed

Chain I:  50% 24% 26%



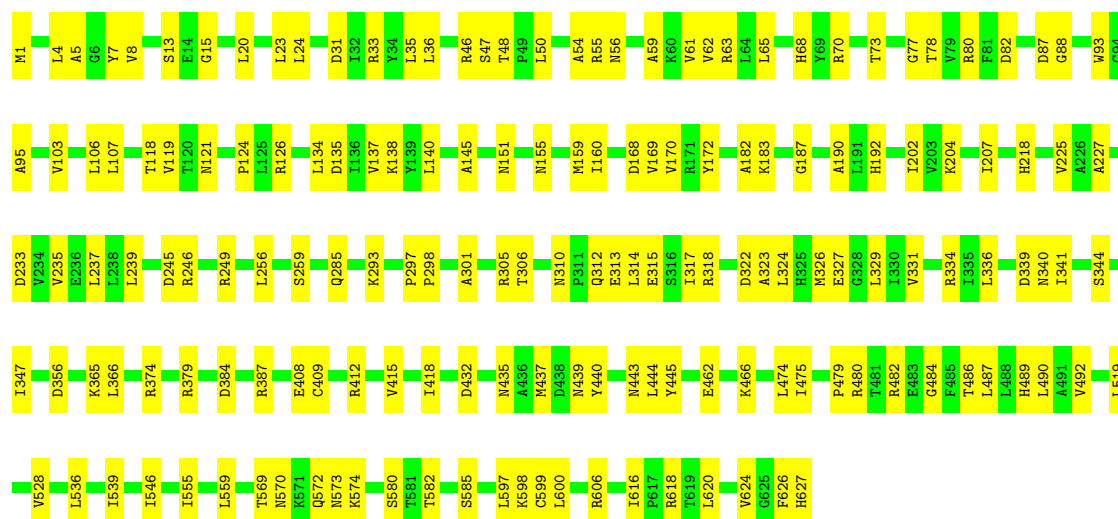
- Molecule 4: E3 ubiquitin-protein ligase RBX1, N-terminally processed

Chain N:  61% 28% 10%



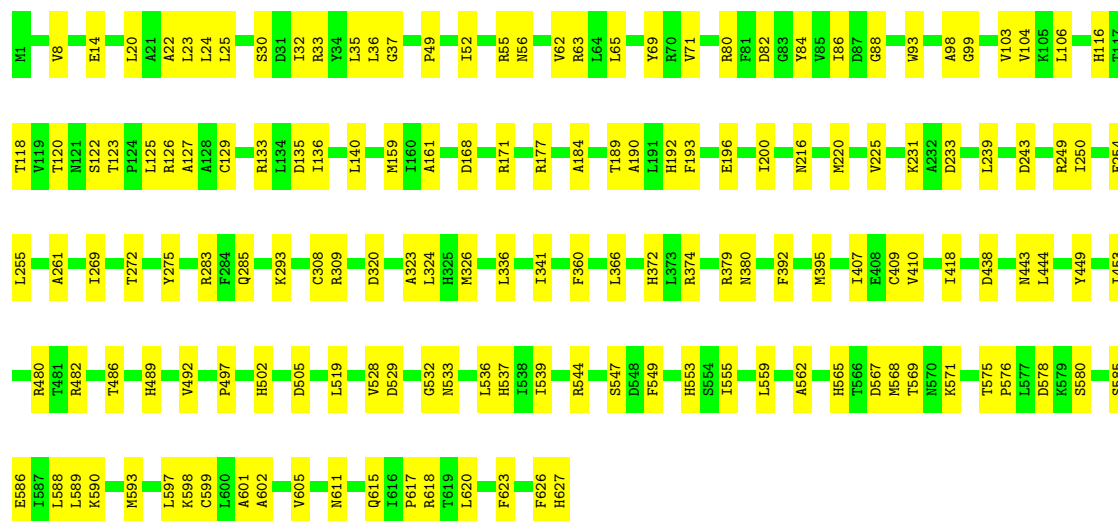
- Molecule 5: Protein fem-1 homolog B

Chain J:  74% 26%



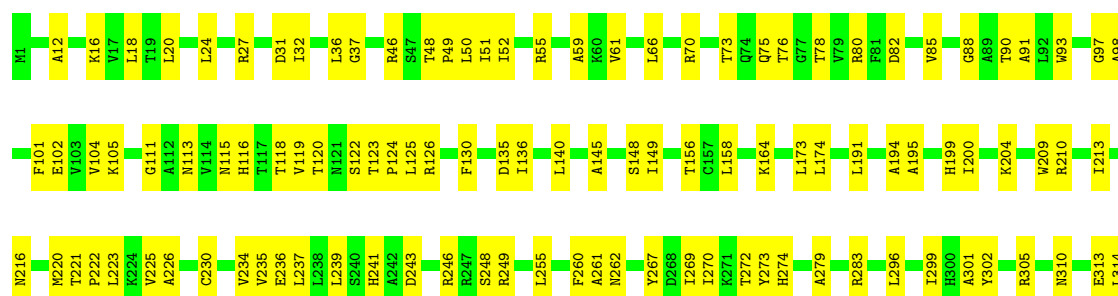
• Molecule 5: Protein fem-1 homolog B

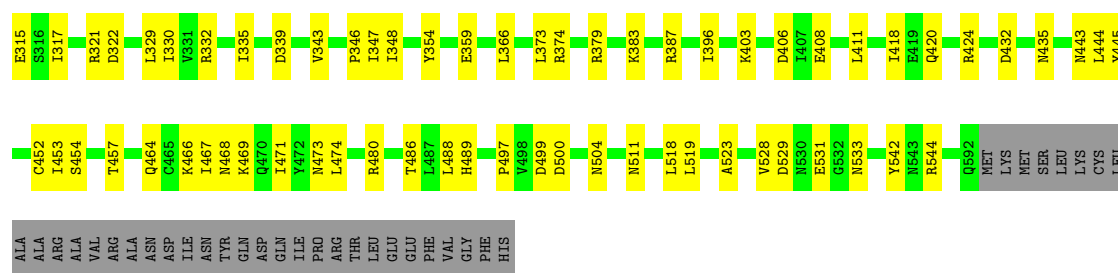
Chain A:  76% 24%



• Molecule 5: Protein fem-1 homolog B

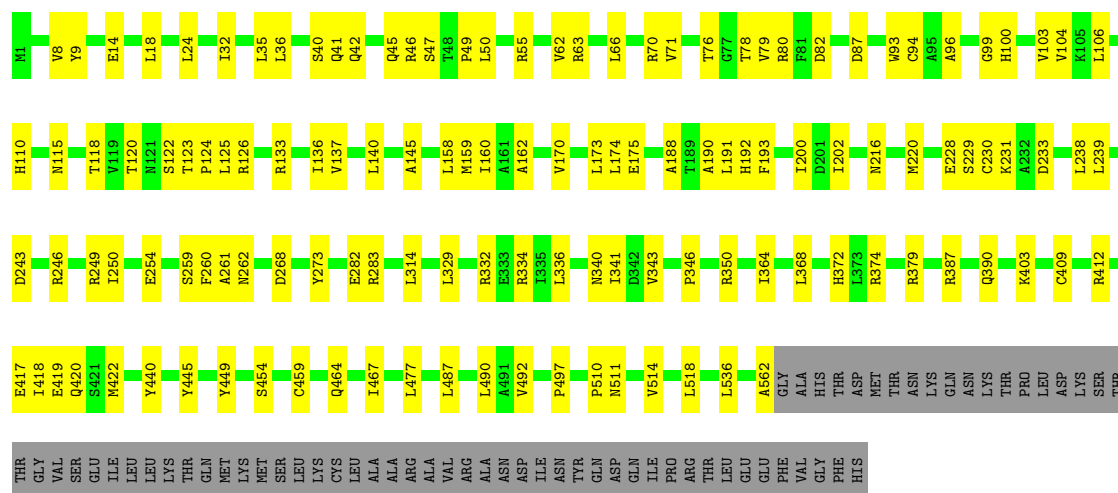
Chain O:  67% 28% 6%





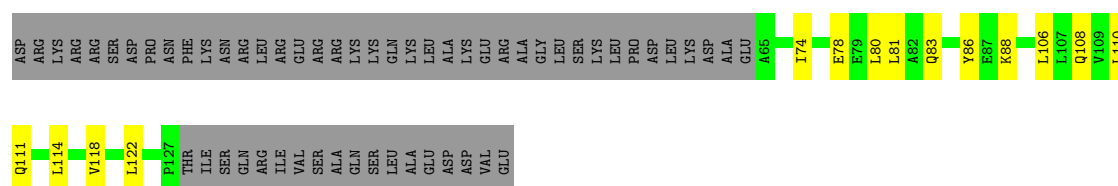
• Molecule 5: Protein fem-1 homolog B

Chain P: 69% 21% 10%



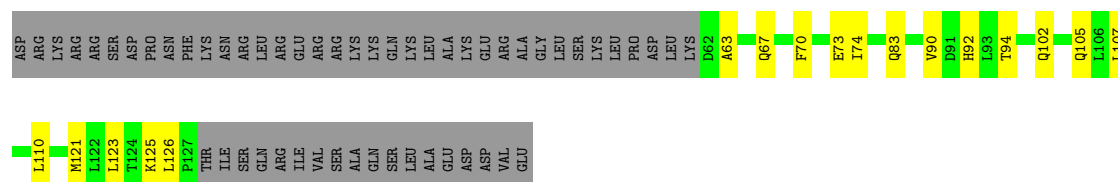
• Molecule 6: Mitochondrial import receptor subunit TOM20 homolog

Chain B: 40% 12% 48%



• Molecule 6: Mitochondrial import receptor subunit TOM20 homolog

Chain G: 40% 14% 45%



• Molecule 6: Mitochondrial import receptor subunit TOM20 homolog

SER	ASP
LEU	ARG
ALA	LYS
GLU	ARG
ASP	ARG
ASP	SER
VAL	PRO
GLU	ASN
	PHE
	LYS
	ASN
	ARG
	LEU
	ARG
	GLU
	ARG
	ARG
	LYS
	LYS
	GLN
	LYS
	LEU
	ALA
	GLY
	GLU
	ALA
	ARG
	GLU
	ASP
	LEU
	LYS
	ASP
	ALA
	GLU
	ALA
	V41
	P90
	F94
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	GLN
	ARG
	ILE
	VAL
	SER
	ALA
	GLN

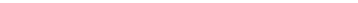
- Chain C:  50% 50%

[illegible]

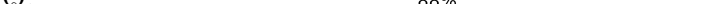
- Chain D:  70% 30%

```

graph LR
    subgraph YellowBox [ ]
        X1
        X2
    end
    X6
    subgraph GreenBox [ ]
        X10
    end
    X1 --> X2
    X2 --> X6
    X6 --> X10
  
```

- Chain R:  100%

- Molecule 8: Poly-UNK

Chain Q:  88% 12%

4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, C1	Depositor
Number of particles used	92948	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING AND AMPLITUDE CORRECTION	Depositor
Microscope	FEI TITAN KRIOS	Depositor
Voltage (kV)	300	Depositor
Electron dose ($e^-/\text{\AA}^2$)	55.8	Depositor
Minimum defocus (nm)	1800	Depositor
Maximum defocus (nm)	2900	Depositor
Magnification	Not provided	
Image detector	GATAN K3 (6k x 4k)	Depositor

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: ZN

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	E	0.12	0/6069	0.30	0/8174
1	K	0.11	0/6063	0.31	0/8166
2	F	0.12	0/777	0.33	0/1050
2	L	0.12	0/777	0.37	0/1050
3	H	0.12	0/774	0.32	0/1045
3	M	0.12	0/774	0.34	0/1045
4	I	0.12	0/603	0.32	0/821
4	N	0.12	0/723	0.31	0/983
5	A	0.13	0/5018	0.38	0/6803
5	J	0.13	0/5018	0.34	0/6803
5	O	0.11	0/4641	0.31	0/6302
5	P	0.11	0/4388	0.31	0/5957
6	B	0.14	0/504	0.36	0/685
6	C	0.06	0/300	0.19	0/416
6	G	0.14	0/526	0.33	0/715
6	S	0.07	0/295	0.21	0/409
All	All	0.12	0/37250	0.33	0/50424

There are no bond length outliers.

There are no bond angle outliers.

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	E	5953	0	5951	92	0
1	K	5947	0	5952	104	0
2	F	760	0	749	12	0
2	L	760	0	749	16	0
3	H	759	0	761	18	0
3	M	759	0	761	22	0
4	I	585	0	544	17	0
4	N	703	0	652	21	0
5	A	4932	0	4912	101	0
5	J	4932	0	4912	107	0
5	O	4562	0	4438	113	0
5	P	4314	0	4180	83	0
6	B	495	0	508	9	0
6	C	301	0	130	0	0
6	G	517	0	523	10	0
6	S	296	0	128	1	0
7	D	50	0	12	2	0
7	R	50	0	12	0	0
8	Q	40	0	10	1	0
9	I	3	0	0	0	0
9	N	3	0	0	0	0
All	All	36721	0	35884	687	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 9.

The worst 5 of 687 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)
3:M:68:ARG:HE	3:M:69:PRO:HD2	1.31	0.94
5:P:230:CYS:SG	5:P:259:SER:OG	2.33	0.85
5:A:537:HIS:HE2	5:A:568:MET:HB3	1.52	0.74
1:K:37:ASP:HA	2:L:63:ARG:HH12	1.52	0.73
5:A:374:ARG:HA	5:A:379:ARG:HH21	1.55	0.71

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 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	E	722/750 (96%)	693 (96%)	29 (4%)	0	100	100
1	K	721/750 (96%)	693 (96%)	28 (4%)	0	100	100
2	F	94/96 (98%)	86 (92%)	8 (8%)	0	100	100
2	L	94/96 (98%)	81 (86%)	13 (14%)	0	100	100
3	H	92/121 (76%)	87 (95%)	5 (5%)	0	100	100
3	M	92/121 (76%)	89 (97%)	3 (3%)	0	100	100
4	I	67/96 (70%)	62 (92%)	5 (8%)	0	100	100
4	N	84/96 (88%)	77 (92%)	7 (8%)	0	100	100
5	A	625/627 (100%)	578 (92%)	47 (8%)	0	100	100
5	J	625/627 (100%)	593 (95%)	32 (5%)	0	100	100
5	O	590/627 (94%)	566 (96%)	24 (4%)	0	100	100
5	P	560/627 (89%)	530 (95%)	30 (5%)	0	100	100
6	B	61/121 (50%)	58 (95%)	3 (5%)	0	100	100
6	C	59/121 (49%)	58 (98%)	1 (2%)	0	100	100
6	G	64/121 (53%)	61 (95%)	3 (5%)	0	100	100
6	S	58/121 (48%)	55 (95%)	3 (5%)	0	100	100
All	All	4608/5118 (90%)	4367 (95%)	241 (5%)	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 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	E	666/679 (98%)	666 (100%)	0	100	100
1	K	666/679 (98%)	666 (100%)	0	100	100
2	F	85/85 (100%)	85 (100%)	0	100	100
2	L	85/85 (100%)	85 (100%)	0	100	100
3	H	84/104 (81%)	84 (100%)	0	100	100
3	M	84/104 (81%)	84 (100%)	0	100	100
4	I	62/82 (76%)	62 (100%)	0	100	100
4	N	74/82 (90%)	74 (100%)	0	100	100
5	A	536/536 (100%)	536 (100%)	0	100	100
5	J	536/536 (100%)	536 (100%)	0	100	100
5	O	476/536 (89%)	476 (100%)	0	100	100
5	P	444/536 (83%)	444 (100%)	0	100	100
6	B	55/107 (51%)	55 (100%)	0	100	100
6	G	57/107 (53%)	57 (100%)	0	100	100
All	All	3910/4258 (92%)	3910 (100%)	0	100	100

There are no protein residues with a non-rotameric sidechain to report.

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 68 such sidechains are listed below:

Mol	Chain	Res	Type
5	P	110	HIS
5	P	357	ASN
5	P	458	GLN
1	K	521	GLN
1	K	492	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 [i](#)

There are no oligosaccharides in this entry.

5.6 Ligand geometry [i](#)

Of 6 ligands modelled in this entry, 6 are monoatomic - leaving 0 for Mogul analysis.

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

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.