wwPDB EM Validation Summary Report (i)

Dec 21, 2025 – 11:42 PM JST

PDB ID	:	9V53 / pdb_00009v53
EMDB ID	:	EMD-64785
Title	:	Structure of TolC, YbjP, and AcrABZ complex
Authors	:	Ge, X.F.; Gu, Z.W.; Wang, J.W.
Deposited on	:	2025-05-25
Resolution	:	3.39 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 (i) 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 (i)) were used in the production of this report:

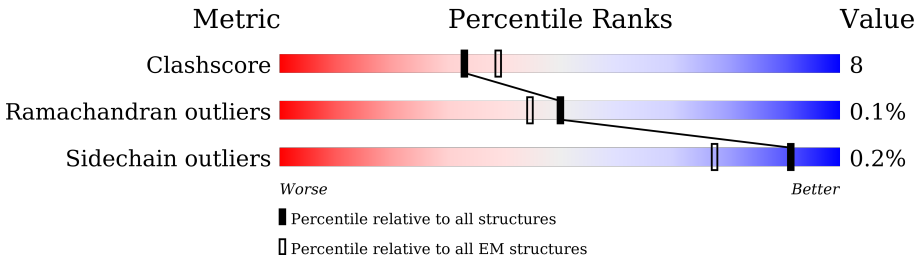
EMDB validation analysis	:	FAILED
MolProbity	:	4-5-2 with Phenix2.0
Percentile statistics	:	20231227.v01 (using entries in the PDB archive December 27th 2023)
EM percentile statistics	:	NOT EXECUTED
MapQ	:	FAILED
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et 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 3.39 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 <=5%

Mol	Chain	Length	Quality of chain
1	C1	493	74% 14% 12%
1	C2	493	69% 19% 12%
1	C3	493	73% 14% 12%
2	P1	171	63% 26% 11%
2	P2	171	63% 25% • 11%
2	P3	171	60% 29% • 11%
3	A1	397	74% 13% 13%
3	A2	397	76% 10% 13%
3	A3	397	76% 11% 13%

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Mol	Chain	Length	Quality of chain
3	a1	397	76% 11% 13%
3	a2	397	76% 11% 13%
3	a3	397	78% 8% 13%
4	BL	1049	77% 21%
4	BO	1049	77% 21%
4	BT	1049	78% 21%
5	ZL	49	49% 31% 20%
5	ZO	49	49% 31% 20%
5	ZT	49	41% 37% 20%

2 Entry composition (i)

There are 5 unique types of molecules in this entry. The entry contains 53464 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 Outer membrane protein TolC.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	C1	432	Total	C	N	O	S	0	0
			3331	2054	591	681	5		
1	C2	432	Total	C	N	O	S	0	0
			3331	2054	591	681	5		
1	C3	432	Total	C	N	O	S	0	0
			3331	2054	591	681	5		

- Molecule 2 is a protein called Uncharacterized lipoprotein YbjP.

Mol	Chain	Residues	Atoms					AltConf	Trace
2	P1	152	Total	C	N	O	S	0	0
			1182	722	218	238	4		
2	P2	152	Total	C	N	O	S	0	0
			1182	722	218	238	4		
2	P3	152	Total	C	N	O	S	0	0
			1182	722	218	238	4		

- Molecule 3 is a protein called Multidrug efflux pump subunit AcrA.

Mol	Chain	Residues	Atoms					AltConf	Trace
3	A1	344	Total	C	N	O	S	0	0
			2587	1617	456	512	2		
3	A2	344	Total	C	N	O	S	0	0
			2587	1617	456	512	2		
3	A3	344	Total	C	N	O	S	0	0
			2587	1617	456	512	2		
3	a2	344	Total	C	N	O	S	0	0
			2587	1617	456	512	2		
3	a1	344	Total	C	N	O	S	0	0
			2587	1617	456	512	2		
3	a3	344	Total	C	N	O	S	0	0
			2587	1617	456	512	2		

- Molecule 4 is a protein called Multidrug efflux pump subunit AcrB.

Mol	Chain	Residues	Atoms					AltConf	Trace
4	BL	1036	Total	C	N	O	S	0	0
			7847	5050	1296	1457	44		
4	BT	1034	Total	C	N	O	S	0	0
			7837	5044	1294	1455	44		
4	BO	1034	Total	C	N	O	S	0	0
			7837	5044	1294	1455	44		

- Molecule 5 is a protein called Multidrug efflux pump accessory protein AcrZ.

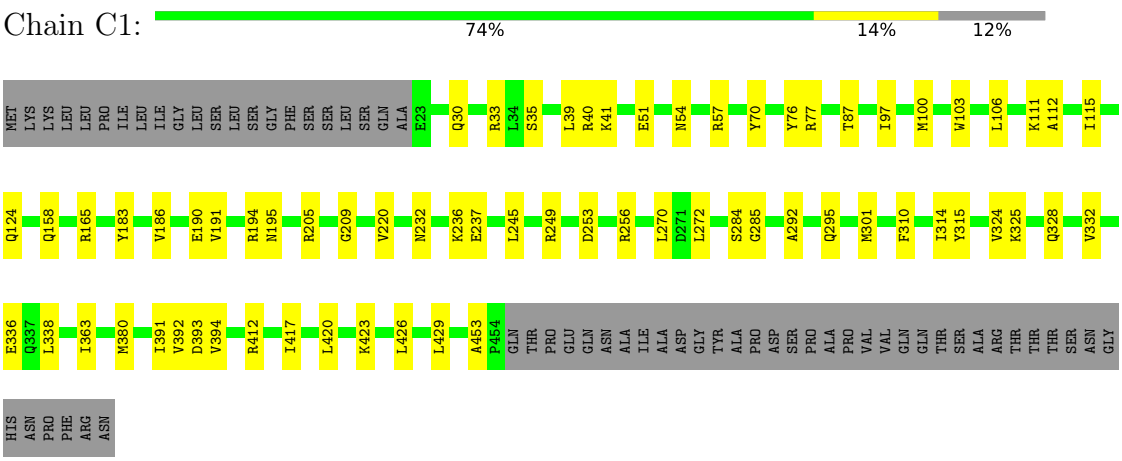
Mol	Chain	Residues	Atoms					AltConf	Trace
5	ZL	39	Total	C	N	O	S	0	0
			294	203	41	47	3		
5	ZT	39	Total	C	N	O	S	0	0
			294	203	41	47	3		
5	ZO	39	Total	C	N	O	S	0	0
			294	203	41	47	3		

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. 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.

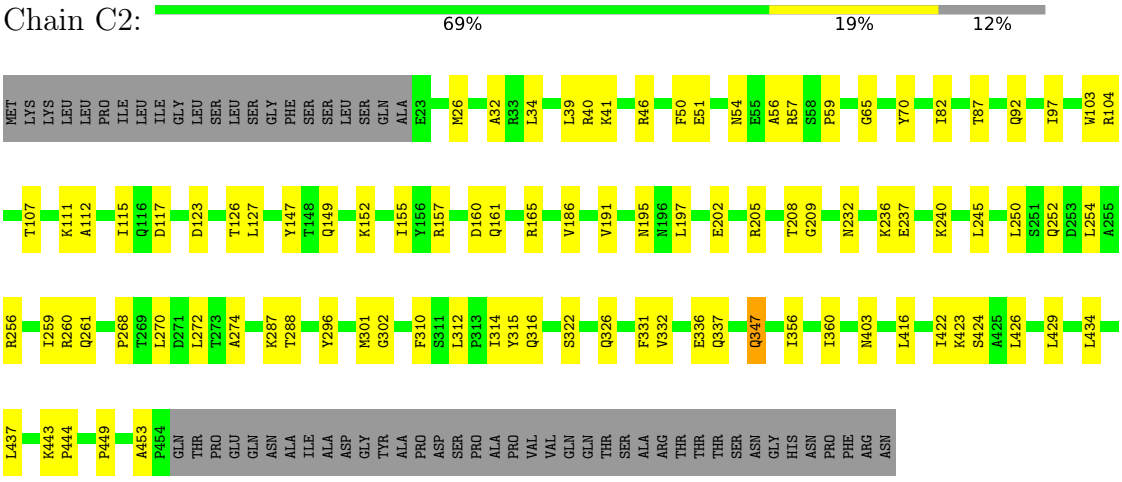
• Molecule 1: Outer membrane protein TolC

Chain C1:



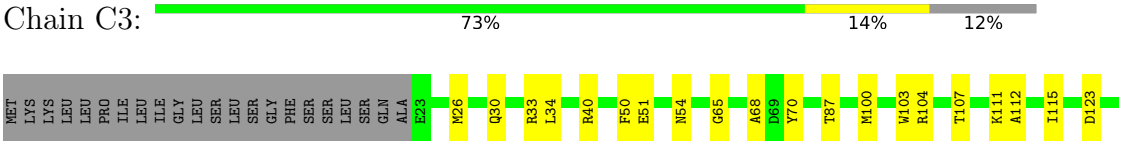
• Molecule 1: Outer membrane protein TolC

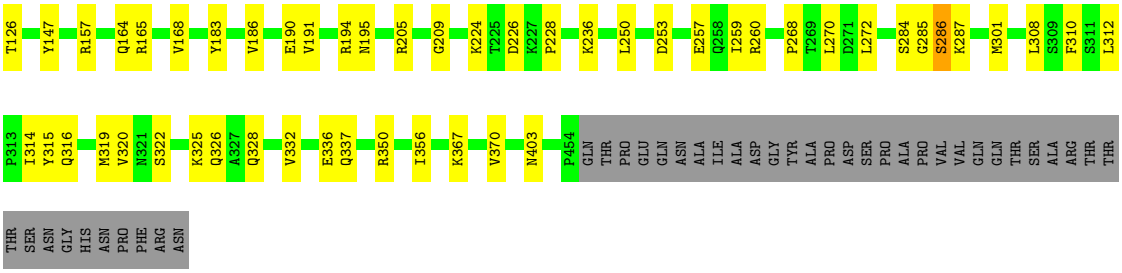
Chain C2:



• Molecule 1: Outer membrane protein TolC

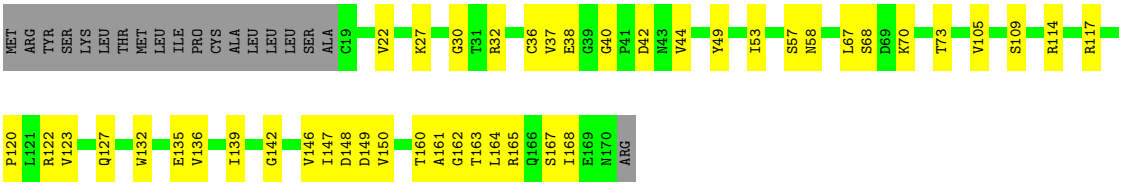
Chain C3:





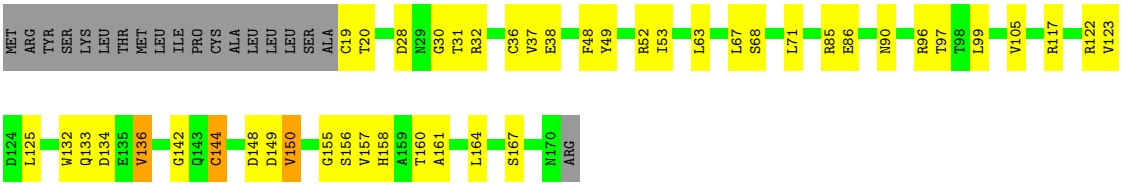
• Molecule 2: Uncharacterized lipoprotein YbjP

Chain P1:



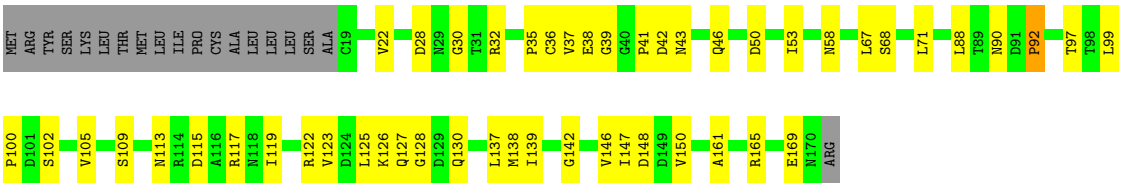
• Molecule 2: Uncharacterized lipoprotein YbjP

Chain P2:



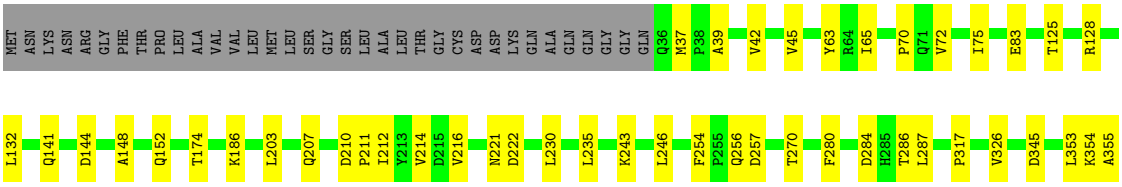
• Molecule 2: Uncharacterized lipoprotein YbjP

Chain P3:



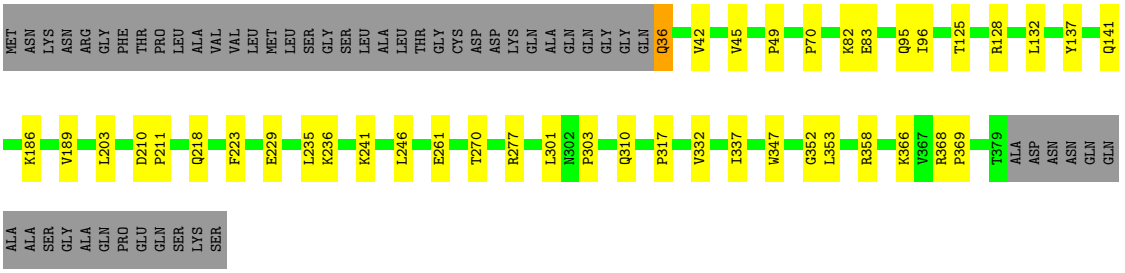
• Molecule 3: Multidrug efflux pump subunit AcrA

Chain A1:



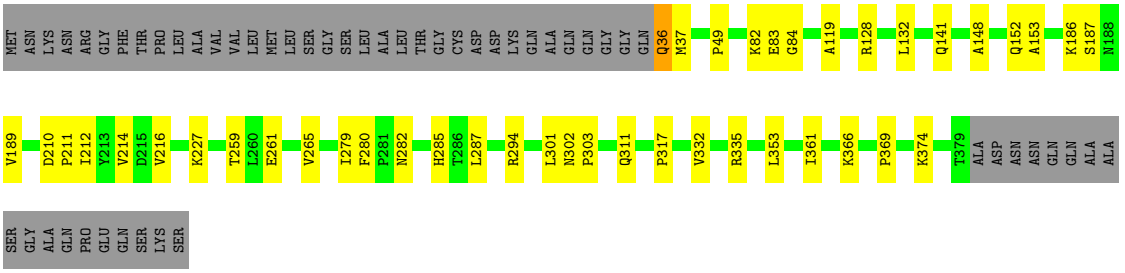
• Molecule 3: Multidrug efflux pump subunit AcrA

Chain A2:



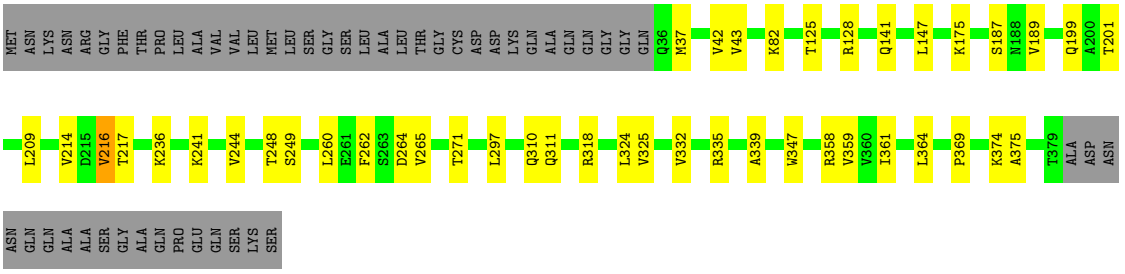
• Molecule 3: Multidrug efflux pump subunit AcrA

Chain A3:



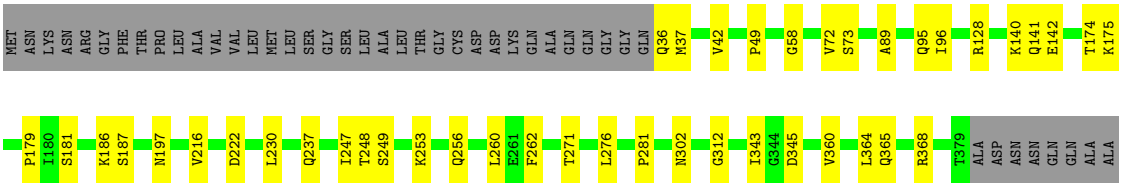
• Molecule 3: Multidrug efflux pump subunit AcrA

Chain a2:



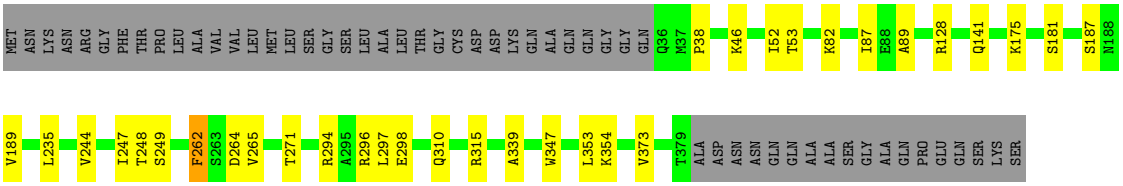
• Molecule 3: Multidrug efflux pump subunit AcrA

Chain a1:



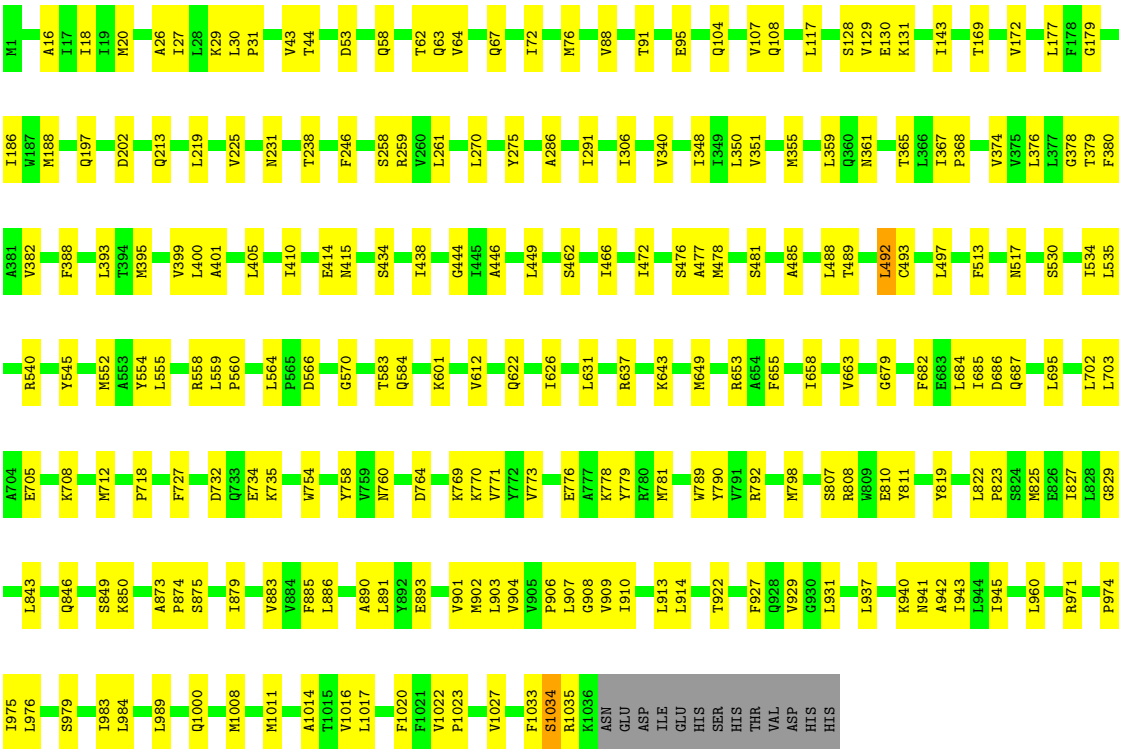
• Molecule 3: Multidrug efflux pump subunit AcrA

Chain a3:



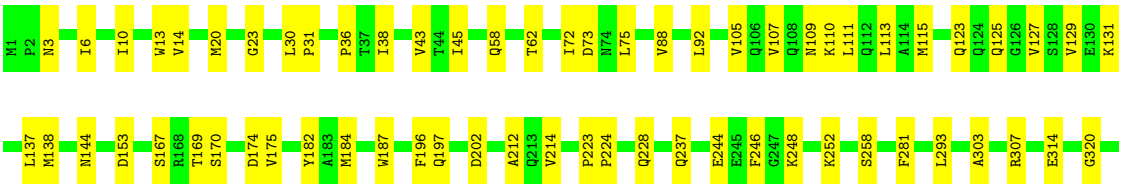
• Molecule 4: Multidrug efflux pump subunit AcrB

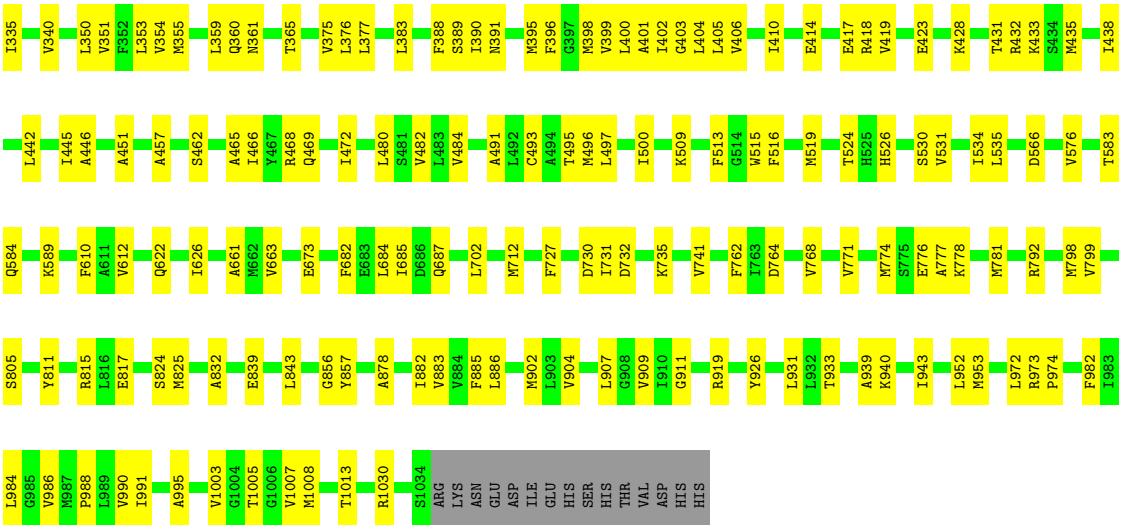
Chain BL:



• Molecule 4: Multidrug efflux pump subunit AcrB

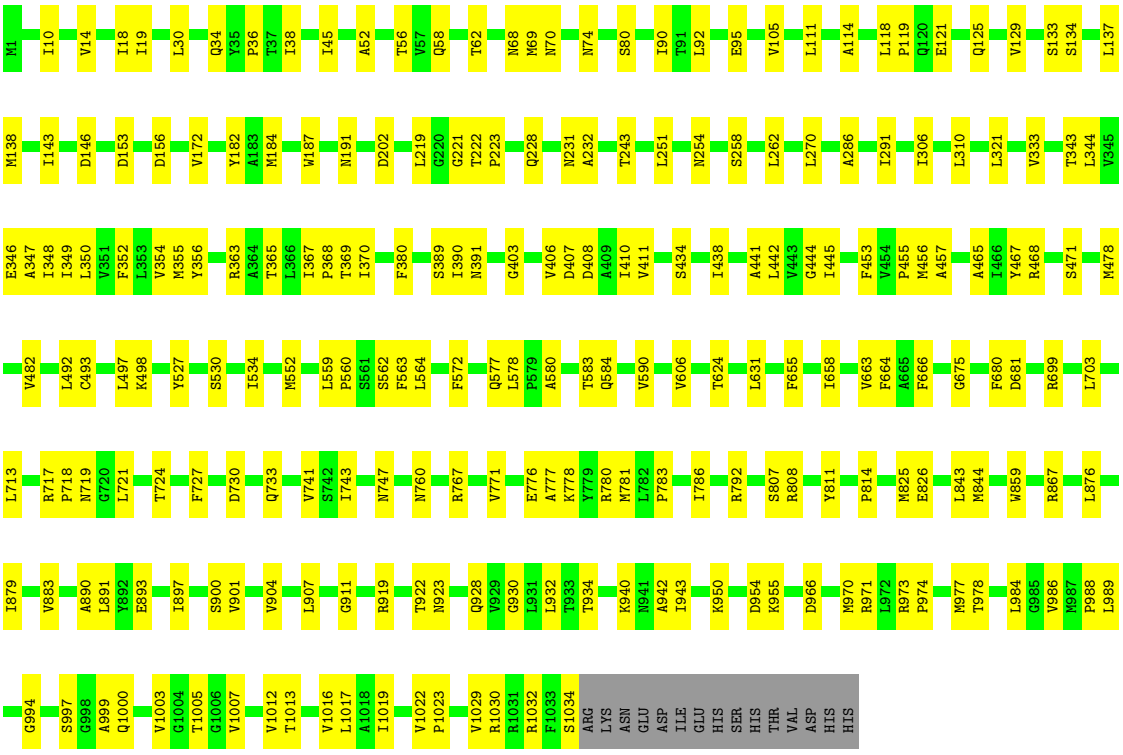
Chain BT:





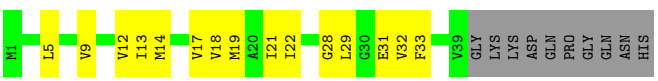
• Molecule 4: Multidrug efflux pump subunit AcrB

Chain BO:



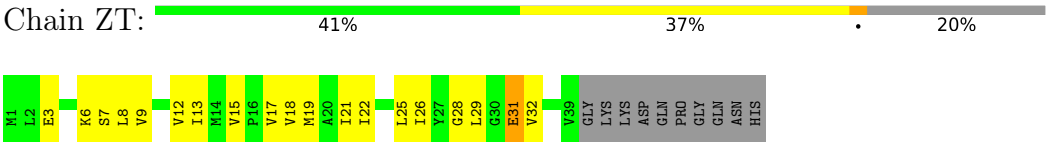
• Molecule 5: Multidrug efflux pump accessory protein AcrZ

Chain ZL:



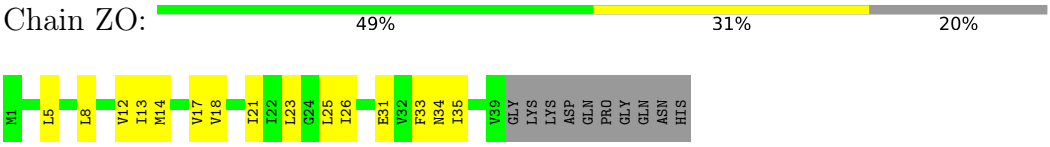
• Molecule 5: Multidrug efflux pump accessory protein AcrZ

Chain ZT:



• Molecule 5: Multidrug efflux pump accessory protein AcrZ

Chain ZO:



4 Experimental information (i)

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	31000	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	NONE	Depositor
Microscope	FEI TECNAI F30	Depositor
Voltage (kV)	300	Depositor
Electron dose ($e^-/Å^2$)	50	Depositor
Minimum defocus (nm)	1200	Depositor
Maximum defocus (nm)	1800	Depositor
Magnification	Not provided	
Image detector	GATAN K3 (6k 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	#$\|Z\|>5$	RMSZ	#$\|Z\|>5$
1	C1	0.12	0/3373	0.25	0/4584
1	C2	0.12	0/3373	0.25	0/4584
1	C3	0.12	0/3373	0.25	0/4584
2	P1	0.12	0/1204	0.35	0/1640
2	P2	0.14	0/1204	0.37	0/1640
2	P3	0.28	1/1204 (0.1%)	0.55	2/1640 (0.1%)
3	A1	0.10	0/2620	0.25	0/3564
3	A2	0.10	0/2620	0.24	0/3564
3	A3	0.10	0/2620	0.25	0/3564
3	a1	0.10	0/2620	0.24	0/3564
3	a2	0.10	0/2620	0.24	0/3564
3	a3	0.09	0/2620	0.22	0/3564
4	BL	0.11	0/7997	0.27	0/10861
4	BO	0.11	0/7987	0.29	0/10847
4	BT	0.12	0/7987	0.29	0/10847
5	ZL	0.22	0/298	0.53	0/403
5	ZO	0.24	0/298	0.68	0/403
5	ZT	0.16	0/298	0.56	0/403
All	All	0.12	1/54316 (0.0%)	0.29	2/73820 (0.0%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	P3	92	PRO	CG-CD	-6.17	1.29	1.50

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
2	P3	92	PRO	CA-N-CD	-11.90	95.34	112.00
2	P3	92	PRO	N-CD-CG	-8.77	90.04	103.20

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	C1	3331	0	3278	57	0
1	C2	3331	0	3278	70	0
1	C3	3331	0	3278	54	0
2	P1	1182	0	1132	37	0
2	P2	1182	0	1132	37	0
2	P3	1182	0	1132	35	0
3	A1	2587	0	2648	33	0
3	A2	2587	0	2648	31	0
3	A3	2587	0	2648	33	0
3	a1	2587	0	2648	28	0
3	a2	2587	0	2648	32	0
3	a3	2587	0	2648	24	0
4	BL	7847	0	7975	164	0
4	BO	7837	0	7971	163	0
4	BT	7837	0	7971	150	0
5	ZL	294	0	330	13	0
5	ZO	294	0	330	10	0
5	ZT	294	0	330	15	0
All	All	53464	0	54025	883	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 8.

The worst 5 of 883 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:A2:36:GLN:HE21	3:A2:36:GLN:N	1.57	1.01
3:A3:36:GLN:HE21	3:A3:36:GLN:N	1.62	0.98
1:C2:259:ILE:HD11	1:C2:331:PHE:HB2	1.61	0.82
3:A2:36:GLN:N	3:A2:36:GLN:NE2	2.27	0.81
3:A3:36:GLN:N	3:A3:36:GLN:NE2	2.30	0.79

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	C1	430/493 (87%)	420 (98%)	10 (2%)	0	100	100
1	C2	430/493 (87%)	421 (98%)	9 (2%)	0	100	100
1	C3	430/493 (87%)	420 (98%)	9 (2%)	1 (0%)	44	72
2	P1	150/171 (88%)	122 (81%)	27 (18%)	1 (1%)	19	47
2	P2	150/171 (88%)	125 (83%)	24 (16%)	1 (1%)	19	47
2	P3	150/171 (88%)	127 (85%)	22 (15%)	1 (1%)	19	47
3	A1	342/397 (86%)	335 (98%)	7 (2%)	0	100	100
3	A2	342/397 (86%)	333 (97%)	9 (3%)	0	100	100
3	A3	342/397 (86%)	332 (97%)	10 (3%)	0	100	100
3	a1	342/397 (86%)	333 (97%)	8 (2%)	1 (0%)	37	66
3	a2	342/397 (86%)	332 (97%)	10 (3%)	0	100	100
3	a3	342/397 (86%)	333 (97%)	8 (2%)	1 (0%)	37	66
4	BL	1034/1049 (99%)	1008 (98%)	25 (2%)	1 (0%)	48	78
4	BO	1032/1049 (98%)	995 (96%)	35 (3%)	2 (0%)	44	72
4	BT	1032/1049 (98%)	1006 (98%)	25 (2%)	1 (0%)	48	78
5	ZL	37/49 (76%)	36 (97%)	1 (3%)	0	100	100
5	ZO	37/49 (76%)	37 (100%)	0	0	100	100
5	ZT	37/49 (76%)	37 (100%)	0	0	100	100
All	All	7001/7668 (91%)	6752 (96%)	239 (3%)	10 (0%)	50	78

5 of 10 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	C3	286	SER
4	BT	777	ALA
4	BO	777	ALA
4	BL	1034	SER

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Mol	Chain	Res	Type
4	BO	222	THR

5.3.2 Protein sidechains (i)

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	C1	361/412 (88%)	361 (100%)	0	100 100
1	C2	361/412 (88%)	360 (100%)	1 (0%)	91 95
1	C3	361/412 (88%)	361 (100%)	0	100 100
2	P1	131/148 (88%)	131 (100%)	0	100 100
2	P2	131/148 (88%)	129 (98%)	2 (2%)	60 76
2	P3	131/148 (88%)	130 (99%)	1 (1%)	79 87
3	A1	278/318 (87%)	278 (100%)	0	100 100
3	A2	278/318 (87%)	277 (100%)	1 (0%)	89 93
3	A3	278/318 (87%)	277 (100%)	1 (0%)	89 93
3	a1	278/318 (87%)	278 (100%)	0	100 100
3	a2	278/318 (87%)	277 (100%)	1 (0%)	89 93
3	a3	278/318 (87%)	278 (100%)	0	100 100
4	BL	834/855 (98%)	831 (100%)	3 (0%)	89 93
4	BO	834/855 (98%)	832 (100%)	2 (0%)	92 96
4	BT	834/855 (98%)	833 (100%)	1 (0%)	92 97
5	ZL	33/41 (80%)	33 (100%)	0	100 100
5	ZO	33/41 (80%)	33 (100%)	0	100 100
5	ZT	33/41 (80%)	32 (97%)	1 (3%)	36 61
All	All	5745/6276 (92%)	5731 (100%)	14 (0%)	91 96

5 of 14 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
4	BL	492	LEU

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Mol	Chain	Res	Type
4	BL	822	LEU
4	BO	741	VAL
5	ZT	31	GLU
4	BO	552	MET

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 70 such sidechains are listed below:

Mol	Chain	Res	Type
4	BT	106	GLN
4	BT	284	GLN
4	BO	517	ASN
2	P1	55	HIS
1	C3	451	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

There are no ligands in this entry.

5.7 Other polymers

There are no such residues in this entry.

5.8 Polymer linkage issues

There are no chain breaks in this entry.