Full wwPDB EM Validation Report

May 5, 2026 – 06:20 PM JST

PDB ID	:	9VXZ / pdb_00009vxz
EMDB ID	:	EMD-65446
Title	:	Cryo-EM structure of Measles Virus L Protein bound by Phosphoprotein Tetramer
Authors	:	Xue, L.; Gui, J.; Chang, T.; Pan, H.; Xiong, X.
Deposited on	:	2025-07-20
Resolution	:	2.68 Å(reported)

This is a Full wwPDB EM Validation 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:

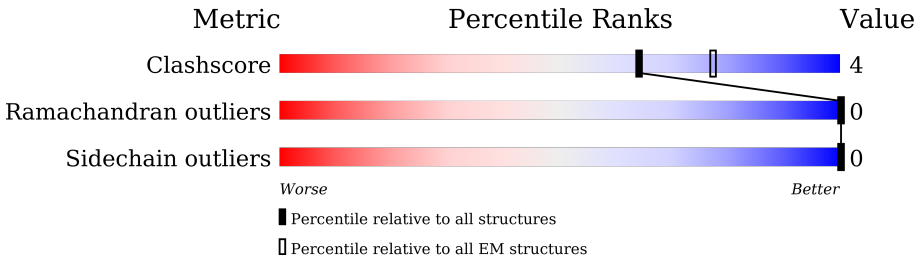
EMDB validation analysis	:	FAILED
MolProbity	:	4-5-2 with Phenix2.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
EM percentile statistics	:	NOT EXECUTED
MapQ	:	FAILED
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
ELECTRON MICROSCOPY

The reported resolution of this entry is 2.68 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	229148	23984
Ramachandran outliers	224038	23583
Sidechain outliers	223484	23102

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	A	2183	51% 6% 43%
2	B	507	24% 5% 71%
2	C	507	8% . 91%
2	D	507	11% . 87%
2	E	507	9% . 89%

2 Entry composition (i)

There are 3 unique types of molecules in this entry. The entry contains 12553 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 RNA-directed RNA polymerase L.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	A	1255	Total	C	N	O	S	0	0
			10082	6445	1743	1839	55		

- Molecule 2 is a protein called Phosphoprotein.

Mol	Chain	Residues	Atoms					AltConf	Trace
2	B	148	Total	C	N	O	S	0	0
			1159	736	208	210	5		
2	C	47	Total	C	N	O	S	0	0
			372	233	65	73	1		
2	D	67	Total	C	N	O	S	0	0
			514	322	87	104	1		
2	E	55	Total	C	N	O	S	0	0
			425	269	74	81	1		

- Molecule 3 is ZINC ION (CCD ID: ZN) (formula: Zn).

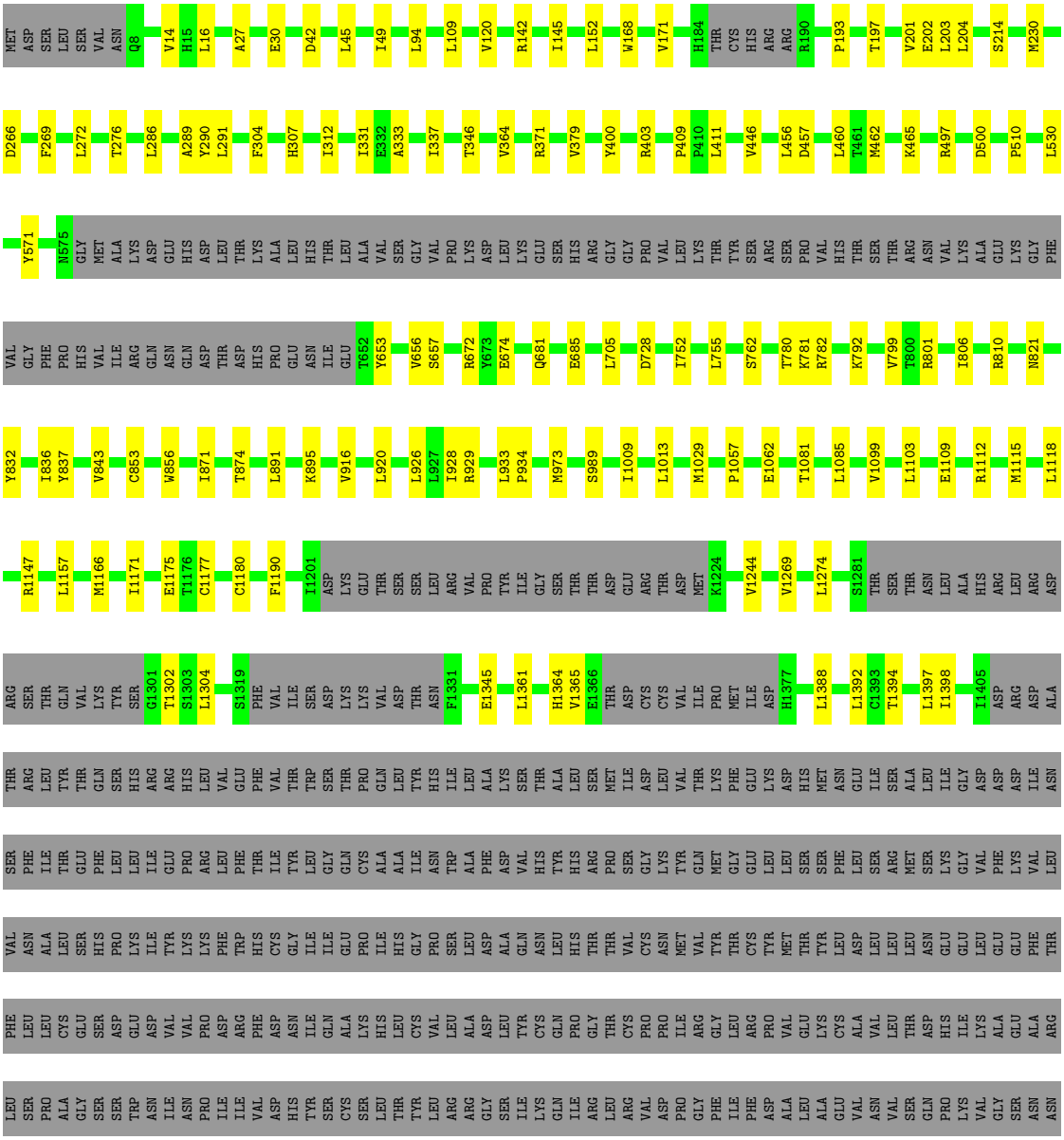
Mol	Chain	Residues	Atoms		AltConf
3	A	1	Total	Zn	0
			1	1	

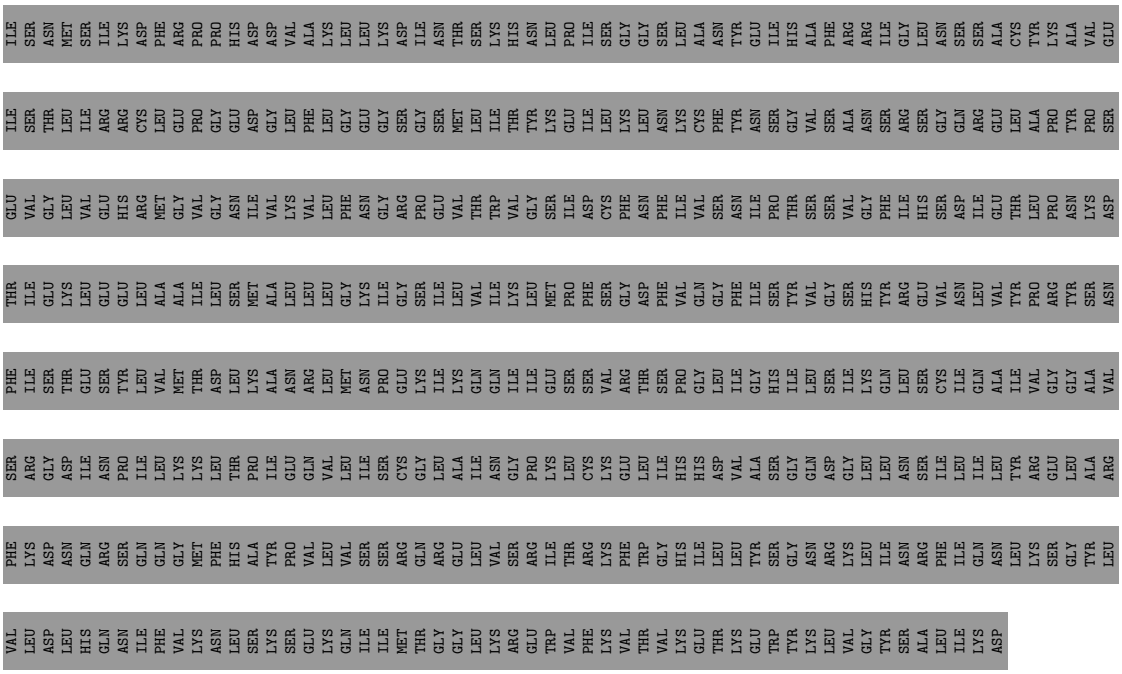
3 Residue-property plots (i)

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. 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: RNA-directed RNA polymerase L

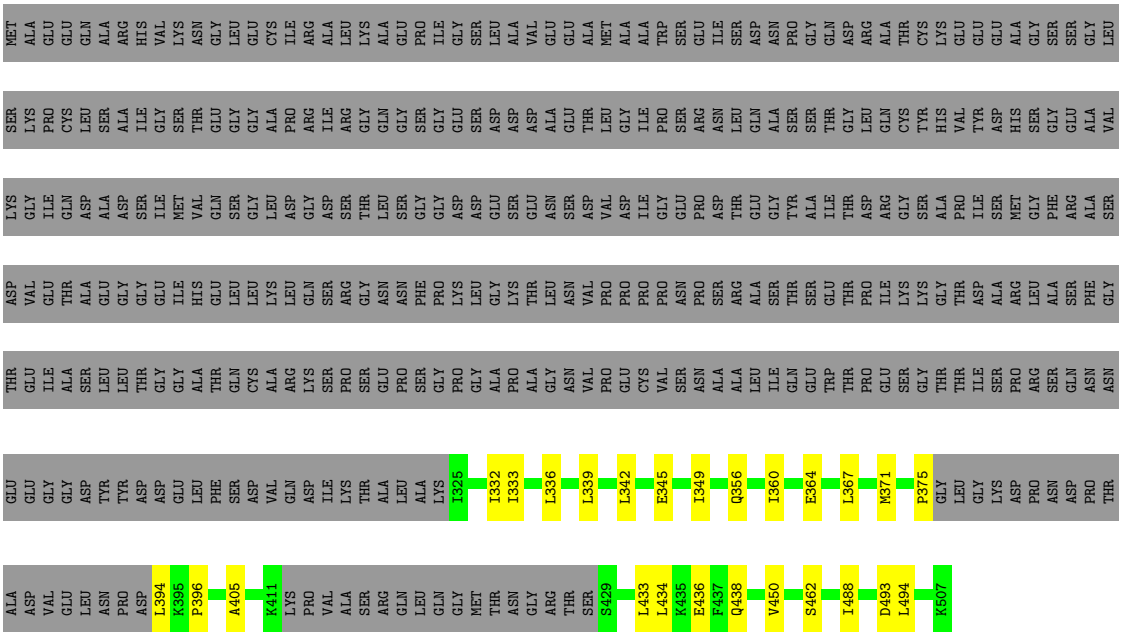
Chain A:





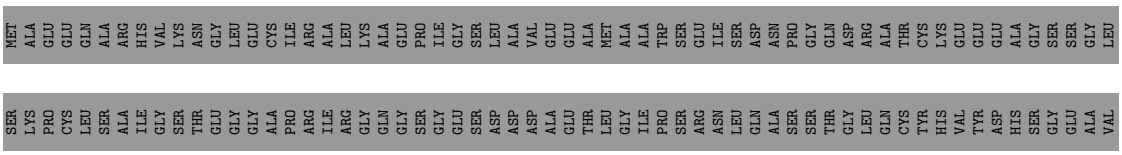
• Molecule 2: Phosphoprotein

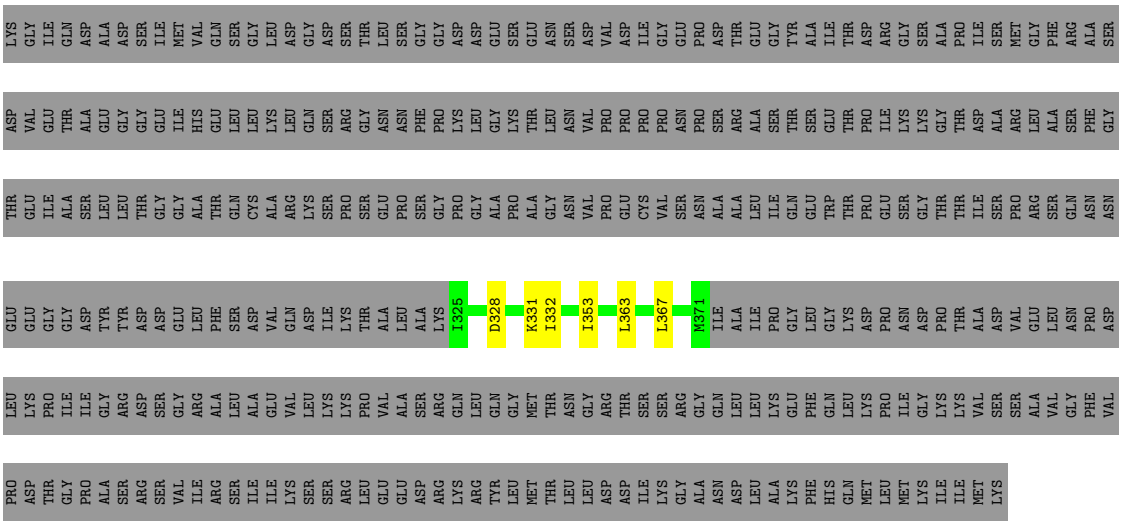
Chain B:



• Molecule 2: Phosphoprotein

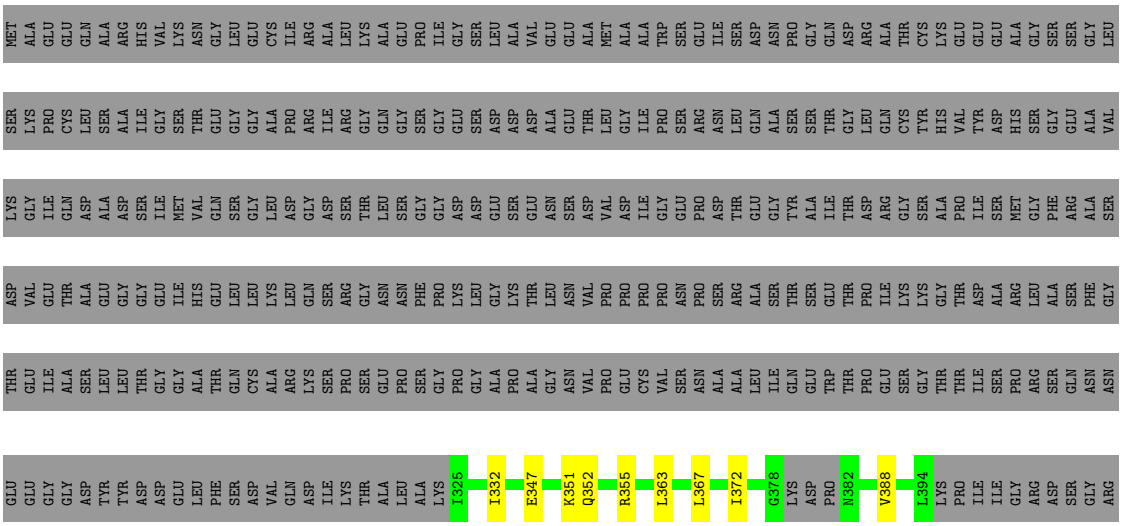
Chain C:

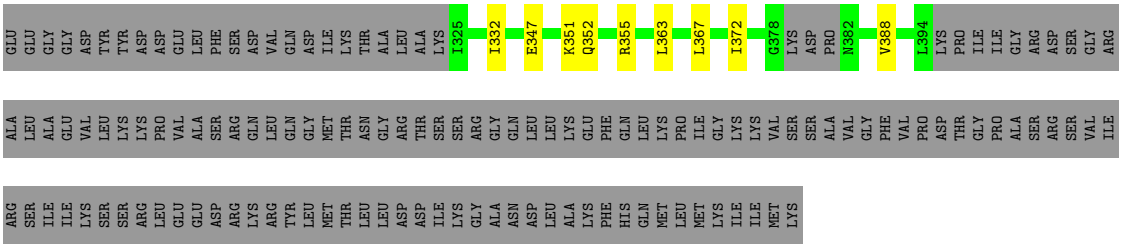




• Molecule 2: Phosphoprotein

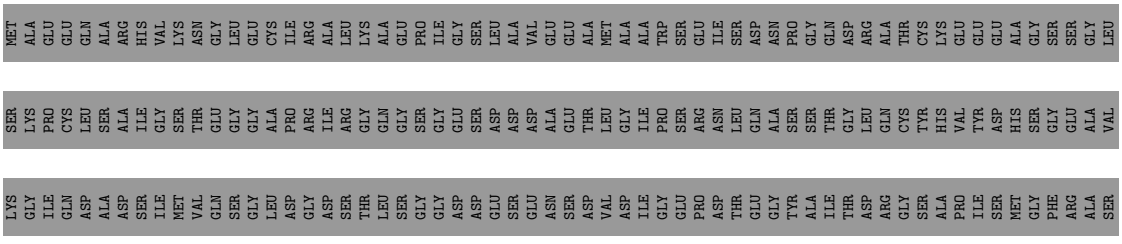
Chain D:

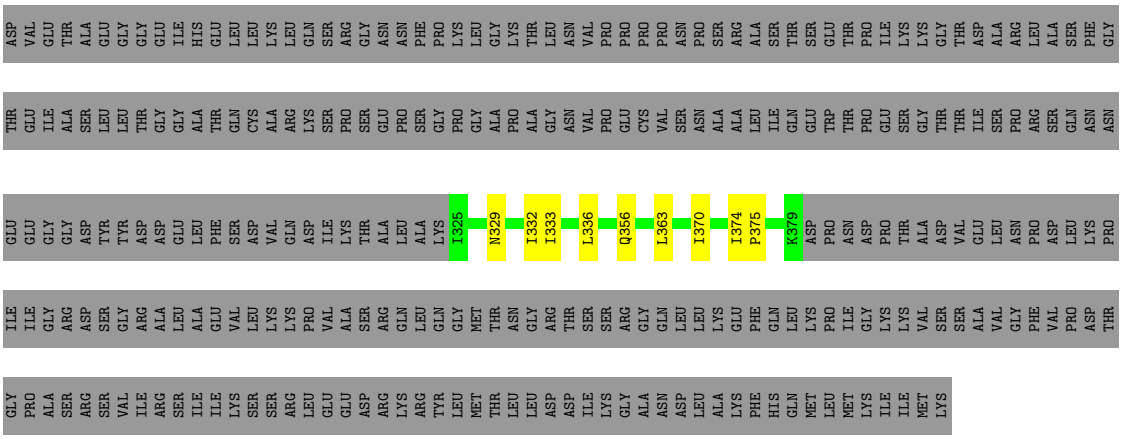




• Molecule 2: Phosphoprotein

Chain E:




ASP VAL GLU THR ALA GLU GLY GLY GLU ILE HIS GLU LEU LEU LYS LEU GLN SER ARG GLY ASN ASN PHE PRO LYS LEU GLY LYS THR LEU ASN VAL PRO PRO PRO PRO ASN PRO SER ARG ALA SER THR SER GLU THR PRO ILE LYS LYS GLY THR ASP ALA ARG LEU ALA SER PHE GLY
THR GLU ILE ALA SER LEU LEU THR GLY GLY ALA THR GLN CYS ALA ARG LYS SER PRO SER GLU PRO SER GLY PRO GLY ALA PRO ALA GLY ASN VAL PRO GLU CYS VAL SER ASN ALA ALA LEU ILE GLN GLU TRP THR PRO GLU SER GLY THR THR ILE SER PRO ARG SER GLN ASN ASN
GLU GLU GLY GLY ASP TYR TYR ASP ASP GLU LEU PHE SER ASP VAL GLN ASP ILE LYS THR ALA LEU ALA LYS I325 N329 I332 I333 L336 Q356 L363 I370 I374 P375 K379 ASP PRO ASN ASP PRO THR ALA ASP VAL GLU LEU ASN PRO ASP LEU LYS PRO
ILE ILE GLY ARG ASP SER GLY ARG ALA LEU ALA GLU VAL LEU LYS LYS PRO VAL ALA SER ARG GLN LEU GLN GLY MET THR ASN GLY ARG THR SER SER ARG GLY GLN LEU LEU LYS GLU PHE GLN LEU LYS PRO ILE GLY LYS LYS VAL SER SER ALA VAL GLY PHE VAL PRO ASP THR
GLY PRO ALA SER ARG SER VAL ILE ARG SER ILE ILE LYS SER SER ARG LEU GLU GLU ASP ARG LYS ARG TYR LEU MET THR LEU LEU ASP ASP ILE LYS GLY ALA ASN ASP LEU ALA LYS PHE HIS GLN MET LEU MET LYS ILE ILE MET LYS

4 Experimental information (i)

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	4035198	Depositor
Resolution determination method	FSC 0.143 CUT-OFF	Depositor
CTF correction method	PHASE FLIPPING AND AMPLITUDE CORRECTION	Depositor
Microscope	TFS KRIOS	Depositor
Voltage (kV)	300	Depositor
Electron dose ($e^-/Å^2$)	50	Depositor
Minimum defocus (nm)	600	Depositor
Maximum defocus (nm)	2400	Depositor
Magnification	Not provided	
Image detector	TFS FALCON 4i (4k 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	A	0.13	0/10307	0.32	0/13966
2	B	0.13	0/1168	0.34	0/1556
2	C	0.17	0/373	0.35	0/497
2	D	0.16	0/517	0.35	0/696
2	E	0.18	0/427	0.43	0/570
All	All	0.13	0/12792	0.32	0/17285

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	A	10082	0	10102	76	0
2	B	1159	0	1261	21	0
2	C	372	0	398	7	0
2	D	514	0	535	8	0
2	E	425	0	462	9	0
3	A	1	0	0	0	0
All	All	12553	0	12758	103	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 4.

All (103) 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:A:1180:CYS:SG	1:A:1364:HIS:HE1	2.11	0.71
2:B:356:GLN:HE21	2:E:356:GLN:HE22	1.37	0.69
2:B:434:LEU:HD23	2:B:436:GLU:H	1.60	0.67
2:B:342:LEU:HA	2:B:345:GLU:HG2	1.76	0.66
1:A:1397:LEU:HD12	1:A:1398:ILE:HG23	1.76	0.66
1:A:989:SER:H	1:A:1147:ARG:HH22	1.45	0.63
2:D:352:GLN:HG2	2:D:355:ARG:HH22	1.63	0.63
1:A:933:LEU:HD12	1:A:934:PRO:HD2	1.80	0.62
1:A:1081:THR:HG22	1:A:1085:LEU:HD23	1.81	0.62
1:A:1190:PHE:HB2	1:A:1361:LEU:HB3	1.83	0.60
2:C:363:LEU:HD23	2:D:363:LEU:HD22	1.86	0.58
1:A:1109:GLU:HG2	1:A:1112:ARG:HH21	1.68	0.57
1:A:530:LEU:HB3	1:A:705:LEU:HD22	1.86	0.57
1:A:457:ASP:HA	1:A:1029:MET:HE1	1.86	0.57
2:E:329:ASN:HA	2:E:332:ILE:HG12	1.86	0.57
1:A:197:THR:HA	1:A:202:GLU:HG2	1.87	0.56
1:A:1057:PRO:HG2	1:A:1157:LEU:HD11	1.88	0.56
2:B:339:LEU:HA	2:B:342:LEU:HD23	1.88	0.56
1:A:266:ASP:HA	1:A:269:PHE:HD2	1.71	0.54
1:A:1269:VAL:HG21	1:A:1274:LEU:HD13	1.88	0.53
1:A:1302:THR:HG22	1:A:1304:LEU:H	1.73	0.53
1:A:456:LEU:HD13	1:A:510:PRO:HB2	1.91	0.52
1:A:1009:ILE:HG23	1:A:1103:LEU:HD22	1.91	0.52
1:A:14:VAL:HG11	1:A:856:TRP:HB2	1.92	0.52
1:A:27:ALA:HB2	1:A:45:LEU:HD21	1.92	0.51
1:A:1392:LEU:HD23	1:A:1394:THR:H	1.75	0.51
1:A:656:VAL:HG21	1:A:792:LYS:HB3	1.93	0.51
1:A:929:ARG:HH12	1:A:1118:LEU:HB3	1.75	0.51
1:A:289:ALA:HB2	1:A:304:PHE:HD2	1.76	0.50
2:B:488:ILE:HG22	2:B:494:LEU:HD12	1.92	0.50
1:A:681:GLN:HG2	2:D:372:ILE:HD13	1.94	0.50
1:A:30:GLU:HB3	1:A:49:ILE:HG21	1.94	0.49
1:A:1166:MET:HG2	1:A:1365:VAL:HG22	1.93	0.49
1:A:16:LEU:HD22	1:A:230:MET:HB2	1.95	0.49
1:A:307:HIS:ND1	1:A:821:ASN:HB3	2.27	0.49
2:E:333:ILE:HA	2:E:336:LEU:HG	1.95	0.49
1:A:460:LEU:HD21	1:A:1029:MET:HG2	1.93	0.49
2:C:328:ASP:O	2:C:332:ILE:HG12	2.12	0.49

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:762:SER:HB3	1:A:806:ILE:HD12	1.95	0.49
1:A:853:CYS:HB2	1:A:874:THR:HG21	1.94	0.49
1:A:333:ALA:O	1:A:337:ILE:HG13	2.13	0.49
1:A:1062:GLU:HG2	1:A:1244:VAL:HG21	1.94	0.48
2:C:367:LEU:HD21	2:D:367:LEU:HD11	1.95	0.48
2:B:375:PRO:HD2	2:B:438:GLN:HE22	1.78	0.48
1:A:193:PRO:HB2	1:A:204:LEU:HD11	1.95	0.48
1:A:781:LYS:HD2	1:A:799:VAL:HG11	1.96	0.48
1:A:752:ILE:HA	1:A:755:LEU:HD12	1.95	0.47
1:A:832:TYR:HE1	1:A:837:TYR:HB2	1.80	0.47
2:B:345:GLU:O	2:B:349:ILE:HG12	2.15	0.47
1:A:371:ARG:HH12	1:A:728:ASP:HA	1.78	0.47
1:A:142:ARG:HB2	1:A:145:ILE:HG13	1.96	0.47
1:A:152:LEU:HD11	1:A:891:LEU:HD13	1.95	0.47
1:A:331:ILE:HG21	2:B:462:SER:HB3	1.96	0.47
2:B:396:PRO:HG2	2:E:370:ILE:HA	1.96	0.47
2:C:367:LEU:HG	2:D:367:LEU:HD21	1.95	0.47
2:B:333:ILE:HD13	2:B:336:LEU:HD12	1.98	0.46
1:A:1171:ILE:HG23	1:A:1175:GLU:HB3	1.97	0.46
1:A:291:LEU:HB2	1:A:346:THR:HG21	1.98	0.46
1:A:836:ILE:HB	1:A:843:VAL:HB	1.98	0.45
1:A:286:LEU:HD22	1:A:290:TYR:HE2	1.81	0.45
1:A:801:ARG:HD2	2:B:450:VAL:HG13	1.98	0.45
2:C:331:LYS:HG3	2:D:332:ILE:HD12	1.99	0.45
1:A:1099:VAL:O	1:A:1103:LEU:HG	2.17	0.45
1:A:497:ARG:HB3	1:A:500:ASP:HB2	1.99	0.45
1:A:920:LEU:HD23	1:A:926:LEU:HD23	1.99	0.45
1:A:1029:MET:HE3	1:A:1397:LEU:HD23	1.99	0.45
1:A:1013:LEU:HD12	1:A:1013:LEU:HA	1.80	0.44
1:A:916:VAL:HA	1:A:1115:MET:HE1	1.98	0.44
1:A:1171:ILE:HD11	1:A:1177:CYS:HB2	1.98	0.44
1:A:171:VAL:HG22	1:A:203:LEU:HD21	1.99	0.44
1:A:201:VAL:HG12	1:A:214:SER:HA	1.97	0.44
1:A:403:ARG:HD2	1:A:571:TYR:HE1	1.81	0.44
1:A:674:GLU:HB2	2:E:374:ILE:HD11	2.00	0.44
1:A:286:LEU:HD11	1:A:312:ILE:HD11	1.99	0.44
1:A:411:LEU:HD11	1:A:446:VAL:HG22	1.99	0.44
1:A:685:GLU:HA	2:D:388:VAL:HG13	2.00	0.44
1:A:462:MET:HA	1:A:465:LYS:HE3	1.99	0.43
1:A:400:TYR:HB3	1:A:409:PRO:HD3	1.99	0.43
1:A:94:LEU:HB3	1:A:168:TRP:HZ2	1.83	0.43

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:D:347:GLU:HG2	2:D:351:LYS:HE3	2.00	0.43
1:A:379:VAL:HG21	2:B:433:LEU:HD11	2.01	0.43
1:A:109:LEU:HD23	1:A:109:LEU:HA	1.91	0.43
1:A:272:LEU:HB3	1:A:276:THR:OG1	2.19	0.43
2:B:332:ILE:O	2:B:336:LEU:HG	2.19	0.43
2:B:488:ILE:HG23	2:B:493:ASP:HB3	2.01	0.43
2:B:364:GLU:HA	2:E:363:LEU:HD21	2.01	0.42
1:A:810:ARG:HA	1:A:810:ARG:HD3	1.84	0.42
1:A:120:VAL:HG11	1:A:928:ILE:HG21	2.01	0.42
1:A:871:ILE:HD13	1:A:895:LYS:HB3	2.01	0.42
2:B:371:MET:HB3	2:B:394:LEU:HD12	2.03	0.41
2:B:332:ILE:HD11	2:C:332:ILE:HG23	2.02	0.41
1:A:1388:LEU:HD23	1:A:1388:LEU:HA	1.92	0.41
1:A:973:MET:HE2	1:A:973:MET:HB3	1.92	0.41
2:B:405:ALA:HB2	2:E:375:PRO:HD3	2.03	0.41
1:A:653:TYR:HD2	1:A:782:ARG:HG2	1.86	0.41
1:A:1304:LEU:HD12	1:A:1345:GLU:HG3	2.02	0.41
2:B:349:ILE:HG23	2:C:353:ILE:HD13	2.03	0.41
2:B:360:ILE:HD13	2:B:360:ILE:HA	1.94	0.41
2:B:367:LEU:HD13	2:E:363:LEU:HD22	2.03	0.41
1:A:291:LEU:HD12	1:A:346:THR:HB	2.03	0.40
1:A:657:SER:HB2	1:A:780:THR:HG22	2.03	0.40
1:A:672:ARG:HD2	2:E:374:ILE:HG21	2.03	0.40
1:A:42:ASP:HB2	1:A:364:VAL:HG21	2.03	0.40

There are no symmetry-related clashes.

5.3 Torsion angles (i)

5.3.1 Protein backbone (i)

In the following table, the Percentiles column shows the percent Ramachandran outliers of the chain as a percentile score with respect to all PDB entries followed by that with respect to all EM entries.

The Analysed column shows the number of residues for which the backbone conformation was analysed, and the total number of residues.

Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	A	1241/2183 (57%)	1199 (97%)	42 (3%)	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
2	B	142/507 (28%)	136 (96%)	6 (4%)	0	100	100
2	C	45/507 (9%)	45 (100%)	0	0	100	100
2	D	63/507 (12%)	63 (100%)	0	0	100	100
2	E	53/507 (10%)	53 (100%)	0	0	100	100
All	All	1544/4211 (37%)	1496 (97%)	48 (3%)	0	100	100

There are no Ramachandran outliers to report.

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	A	1114/1945 (57%)	1114 (100%)	0	100	100
2	B	132/416 (32%)	132 (100%)	0	100	100
2	C	45/416 (11%)	45 (100%)	0	100	100
2	D	61/416 (15%)	61 (100%)	0	100	100
2	E	50/416 (12%)	50 (100%)	0	100	100
All	All	1402/3609 (39%)	1402 (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. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	313	HIS
1	A	358	HIS
2	B	326	HIS
2	B	356	GLN

5.3.3 RNA (i)

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

Of 1 ligands modelled in this entry, 1 is 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

There are no such residues in this entry.

5.8 Polymer linkage issues

There are no chain breaks in this entry.