



Full wwPDB EM Validation Report ⓘ

Jul 16, 2025 – 01:25 AM JST

PDB ID : 8WH5 / pdb_00008wh5
EMDB ID : EMD-37529
Title : Structure of DDM1-nucleosome complex in the apo state
Authors : Liu, Y.; Zhang, Z.; Du, J.
Deposited on : 2023-09-22
Resolution : 3.58 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 Phenix2.0rc1
Percentile statistics : 20231227.v01 (using entries in the PDB archive December 27th 2023)
MapQ : **FAILED**
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.44

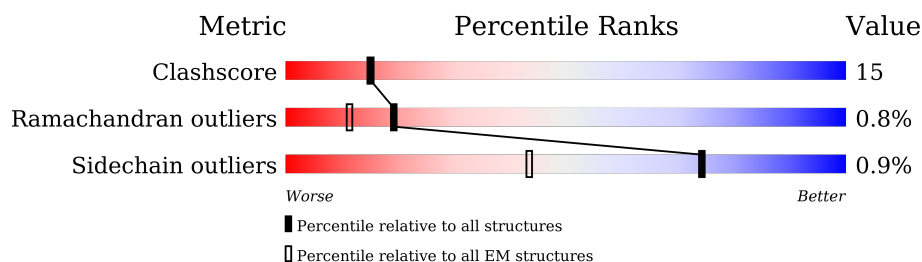
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

ELECTRON MICROSCOPY

The reported resolution of this entry is 3.58 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	A	136	56% 13% 31%
1	E	136	47% 15% 38%
2	B	103	60% 14% 25%
2	F	103	74% 11% 16%
3	C	130	55% 12% 32%
3	G	130	57% 18% 24%
4	D	150	48% 11% 41%
4	H	150	42% 19% 39%
5	I	167	34% 45% 20%

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Mol	Chain	Length	Quality of chain
6	J	167	
7	K	765	

2 Entry composition

There are 7 unique types of molecules in this entry. The entry contains 14663 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 Histone H3.1.

Mol	Chain	Residues	Atoms					AltConf	Trace
1	A	94	Total	C	N	O	S	0	0
			766	486	145	133	2		
1	E	85	Total	C	N	O	S	0	0
			695	440	130	123	2		

- Molecule 2 is a protein called Histone H4.

Mol	Chain	Residues	Atoms					AltConf	Trace
2	B	77	Total	C	N	O	S	0	0
			617	390	121	105	1		
2	F	87	Total	C	N	O	S	0	0
			706	444	144	117	1		

- Molecule 3 is a protein called Histone H2A.6.

Mol	Chain	Residues	Atoms					AltConf	Trace
3	C	88	Total	C	N	O	S	0	0
			662	421	123	118			
3	G	99	Total	C	N	O	S	0	0
			750	475	141	133	1		

- Molecule 4 is a protein called Histone H2B.6.

Mol	Chain	Residues	Atoms					AltConf	Trace
4	D	89	Total	C	N	O	S	0	0
			694	446	118	128	2		
4	H	92	Total	C	N	O	S	0	0
			716	459	121	134	2		

- Molecule 5 is a DNA chain called DNA (sense strand).

Mol	Chain	Residues	Atoms					AltConf	Trace
5	I	133	Total	C	N	O	P	0	0
			2710	1285	494	798	133		

- Molecule 6 is a DNA chain called DNA (antisense strand).

Mol	Chain	Residues	Atoms					AltConf	Trace
6	J	133	Total	C	N	O	P	0	0
			2743	1296	516	798	133		

- Molecule 7 is a protein called ATP-dependent DNA helicase DDM1.

Mol	Chain	Residues	Atoms					AltConf	Trace
7	K	445	Total	C	N	O	S	0	0
			3604	2306	648	632	18		

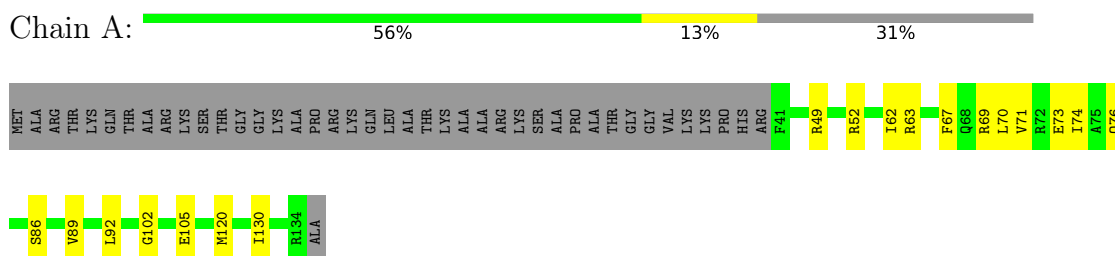
There is a discrepancy between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
K	0	SER	-	expression tag	UNP Q9XFH4

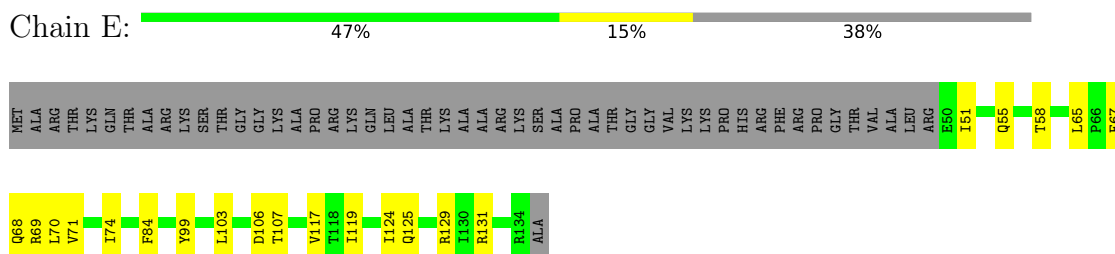
3 Residue-property plots [i](#)

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.

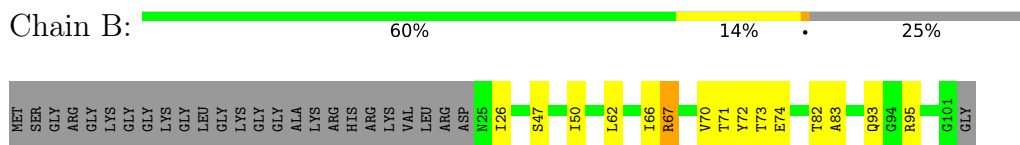
- Molecule 1: Histone H3.1



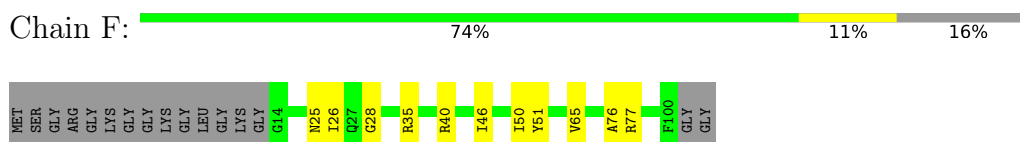
- Molecule 1: Histone H3.1



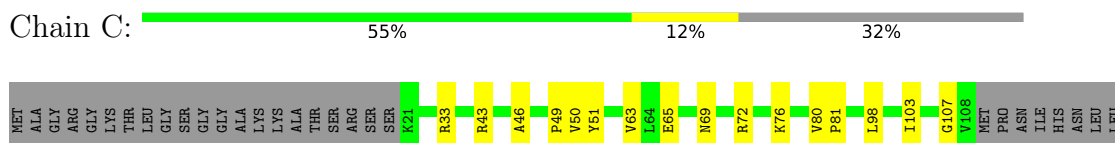
- Molecule 2: Histone H4



- Molecule 2: Histone H4



- Molecule 3: Histone H2A.6



4 Experimental information

Property	Value	Source
EM reconstruction method	SINGLE PARTICLE	Depositor
Imposed symmetry	POINT, Not provided	
Number of particles used	56233	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 ($e^-/\text{\AA}^2$)	50	Depositor
Minimum defocus (nm)	1000	Depositor
Maximum defocus (nm)	2500	Depositor
Magnification	Not provided	
Image detector	GATAN K3 (6k x 4k)	Depositor

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	1.10	0/776	1.22	1/1041 (0.1%)
1	E	0.92	0/703	1.09	1/942 (0.1%)
2	B	1.07	0/624	1.17	3/836 (0.4%)
2	F	0.94	0/714	1.04	1/954 (0.1%)
3	C	0.94	0/670	1.08	3/904 (0.3%)
3	G	0.96	0/760	1.13	1/1026 (0.1%)
4	D	0.86	0/705	1.03	2/947 (0.2%)
4	H	1.07	2/727 (0.3%)	1.40	9/977 (0.9%)
5	I	0.40	0/3036	0.64	3/4679 (0.1%)
6	J	0.40	0/3080	0.58	1/4756 (0.0%)
7	K	0.93	4/3678 (0.1%)	1.15	14/4958 (0.3%)
All	All	0.79	6/15473 (0.0%)	0.96	39/22020 (0.2%)

All (6) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
7	K	653	SER	C-O	7.84	1.31	1.24
4	H	136	VAL	C-O	-7.82	1.15	1.24
7	K	258	PRO	C-O	-6.55	1.15	1.24
7	K	491	ILE	C-O	-5.25	1.19	1.24
7	K	653	SER	CA-C	5.09	1.59	1.52
4	H	148	SER	N-CA	5.06	1.52	1.46

All (39) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	I	107	DC	C2'-C3'-O3'	10.17	126.76	111.50
6	J	112	DG	C2'-C3'-O3'	9.67	126.00	111.50
4	H	104	LYS	N-CA-C	-7.59	103.00	111.28
7	K	518	GLU	N-CA-C	-7.58	104.94	114.56
4	D	107	ARG	N-CA-C	-6.85	103.50	110.97
7	K	286	ASN	N-CA-C	-6.62	104.14	111.82
2	F	65	VAL	N-CA-C	6.51	116.67	110.42

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
7	K	244	LEU	N-CA-C	-6.46	104.16	111.07
2	B	93	GLN	N-CA-C	6.30	119.99	112.93
7	K	494	ARG	N-CA-C	-5.99	104.32	111.69
7	K	537	PHE	N-CA-C	-5.96	105.09	112.90
7	K	516	VAL	N-CA-C	-5.93	103.64	111.05
7	K	653	SER	N-CA-C	5.75	115.98	107.88
4	H	76	ASP	N-CA-C	5.70	116.58	108.54
4	H	136	VAL	CA-C-O	-5.69	115.35	121.27
5	I	130	DC	C2'-C3'-O3'	-5.60	103.10	111.50
7	K	663	TYR	CB-CA-C	-5.57	102.14	110.88
4	H	142	ALA	CA-C-N	-5.55	112.55	120.42
4	H	142	ALA	C-N-CA	-5.55	112.55	120.42
4	H	125	LEU	N-CA-C	5.54	120.20	113.38
7	K	517	GLU	N-CA-C	-5.45	105.44	113.72
4	H	129	GLY	N-CA-C	5.41	121.63	112.22
2	B	67	ARG	CA-C-N	-5.40	113.04	120.28
2	B	67	ARG	C-N-CA	-5.40	113.04	120.28
4	H	84	MET	N-CA-C	-5.39	106.48	113.16
7	K	516	VAL	CA-C-O	-5.34	114.85	120.57
5	I	41	DA	C4'-C3'-O3'	5.34	118.01	110.00
1	E	84	PHE	N-CA-C	5.33	116.14	107.23
7	K	663	TYR	CA-C-O	-5.30	115.26	120.82
3	C	69	ASN	N-CA-C	-5.25	105.64	111.36
7	K	663	TYR	N-CA-CB	5.25	117.62	110.01
3	C	51	TYR	N-CA-C	5.24	117.39	111.11
7	K	553	LEU	N-CA-C	-5.23	105.58	111.28
3	G	27	PRO	CB-CA-C	-5.21	107.49	111.87
3	C	50	VAL	O-C-N	-5.20	116.58	121.94
4	D	98	LEU	CA-C-O	-5.13	115.41	120.90
1	A	120	MET	CA-C-O	-5.12	116.52	121.08
7	K	244	LEU	CA-C-O	-5.11	115.45	120.82
4	H	115	THR	N-CA-C	5.02	117.64	109.86

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	766	0	807	12	0
1	E	695	0	730	19	0
2	B	617	0	658	13	0
2	F	706	0	759	8	0
3	C	662	0	696	14	0
3	G	750	0	787	20	0
4	D	694	0	734	14	0
4	H	716	0	754	17	0
5	I	2710	0	1491	104	0
6	J	2743	0	1491	90	0
7	K	3604	0	3711	135	0
All	All	14663	0	12618	393	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 15.

All (393) 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)
7:K:459:PHE:CE2	7:K:500:PRO:HB3	2.02	0.94
5:I:101:DG:C2	5:I:102:DG:H1'	2.11	0.85
5:I:100:DG:H2'	5:I:101:DG:C8	2.16	0.81
5:I:3:DC:H42	6:J:145:DG:H1	1.29	0.79
5:I:121:DG:H1	6:J:26:DC:H42	1.29	0.79
7:K:459:PHE:CD2	7:K:500:PRO:HB3	2.19	0.78
7:K:459:PHE:HE2	7:K:500:PRO:CB	1.98	0.76
5:I:111:DC:H42	6:J:37:DG:H1	1.32	0.76
5:I:34:DG:H2''	5:I:35:DT:H5''	1.67	0.75
6:J:24:DT:H2'	6:J:25:DG:O4'	1.91	0.70
7:K:459:PHE:CE2	7:K:500:PRO:CB	2.74	0.70
5:I:101:DG:N2	5:I:102:DG:H1'	2.08	0.68
7:K:365:LEU:HD11	7:K:372:LEU:HD13	1.76	0.68
6:J:133:DA:H1'	6:J:134:DC:H5'	1.77	0.66
7:K:365:LEU:HD11	7:K:372:LEU:HB2	1.77	0.66
2:B:47:SER:H	2:B:50:ILE:HD12	1.61	0.65
7:K:462:HIS:HB3	7:K:468:LEU:HA	1.79	0.64
3:C:43:ARG:NH2	5:I:113:DA:H1'	2.12	0.64
5:I:4:DG:H1'	5:I:5:DA:OP2	1.97	0.64
7:K:300:VAL:HG13	7:K:304:PHE:CB	2.28	0.64
6:J:139:DA:H1'	6:J:140:DT:H5'	1.81	0.63
7:K:233:LYS:HG2	7:K:234:THR:H	1.62	0.63
7:K:552:LEU:HD21	7:K:618:TYR:CD2	2.34	0.62

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
6:J:94:DG:H2''	6:J:95:DG:O5'	1.99	0.62
5:I:110:DC:H4'	5:I:111:DC:OP1	1.99	0.62
7:K:626:MET:HA	7:K:626:MET:HE2	1.79	0.62
7:K:228:GLN:CG	7:K:432:MET:HA	2.30	0.62
7:K:252:PRO:HB2	7:K:327:TRP:HA	1.80	0.62
3:C:33:ARG:HH21	6:J:29:DG:P	2.22	0.62
7:K:221:LEU:HB3	7:K:427:PHE:HE1	1.64	0.61
7:K:490:VAL:HG22	7:K:657:ARG:HH22	1.65	0.61
7:K:552:LEU:HD11	7:K:618:TYR:CE2	2.34	0.61
5:I:111:DC:H2''	5:I:112:DT:H71	1.81	0.61
6:J:17:DT:H2''	6:J:18:DG:C8	2.35	0.61
6:J:144:DC:H2''	6:J:145:DG:C8	2.35	0.61
7:K:294:LYS:O	7:K:294:LYS:NZ	2.33	0.61
7:K:544:LEU:HD21	7:K:609:LEU:HD11	1.83	0.61
6:J:112:DG:H2'	6:J:113:DA:C8	2.35	0.61
7:K:233:LYS:HG2	7:K:234:THR:N	2.16	0.61
4:D:140:THR:O	4:D:144:THR:HG23	2.01	0.60
7:K:226:ALA:HA	7:K:361:THR:O	2.01	0.60
5:I:133:DA:H2''	5:I:134:DT:C5	2.36	0.60
7:K:285:LYS:HB3	7:K:288:ARG:NH2	2.16	0.60
7:K:291:LEU:HD13	7:K:320:ARG:HH11	1.67	0.60
2:B:50:ILE:CD1	1:E:119:ILE:HG23	2.32	0.60
6:J:53:DG:H3'	6:J:54:DG:H21	1.66	0.60
6:J:135:DC:H2''	6:J:136:DG:C8	2.36	0.60
7:K:291:LEU:HD22	7:K:320:ARG:NH1	2.16	0.59
7:K:542:LYS:HB2	7:K:612:ALA:HA	1.84	0.59
3:G:54:ALA:HB3	4:H:139:GLY:HA2	1.84	0.59
7:K:251:GLY:H	7:K:300:VAL:HG11	1.68	0.59
7:K:228:GLN:HG2	7:K:432:MET:HA	1.84	0.59
6:J:18:DG:H2'	6:J:19:DA:H8	1.68	0.58
7:K:620:SER:O	7:K:621:ASP:OD1	2.22	0.58
5:I:38:DT:H2''	5:I:39:DA:C8	2.38	0.58
6:J:135:DC:H4'	6:J:136:DG:OP2	2.04	0.58
5:I:12:DC:H2'	5:I:13:DG:C8	2.39	0.58
5:I:111:DC:N3	6:J:37:DG:N2	2.52	0.58
6:J:14:DA:H1'	6:J:15:DT:C6	2.38	0.58
5:I:100:DG:H2'	5:I:101:DG:H8	1.67	0.58
7:K:285:LYS:O	7:K:288:ARG:HB3	2.04	0.58
7:K:261:THR:O	7:K:265:TRP:HD1	1.87	0.57
7:K:380:LEU:HD13	7:K:383:ILE:HD12	1.87	0.57
6:J:141:DT:H2''	6:J:142:DC:C6	2.39	0.57

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
6:J:131:DG:H2''	6:J:132:DC:C6	2.39	0.57
7:K:605:LEU:HD12	7:K:633:ARG:HG2	1.84	0.57
5:I:110:DC:H1'	5:I:111:DC:C2	2.39	0.57
5:I:5:DA:H8	5:I:5:DA:OP1	1.88	0.56
5:I:120:DA:N6	6:J:27:DC:N3	2.49	0.56
7:K:605:LEU:HA	7:K:633:ARG:NE	2.21	0.56
6:J:28:DT:H4'	6:J:28:DT:OP1	2.07	0.55
5:I:89:DA:C2	6:J:60:DA:C2	2.94	0.55
7:K:291:LEU:HD22	7:K:320:ARG:HH12	1.71	0.55
2:B:66:ILE:HD12	1:E:74:ILE:CG2	2.37	0.55
5:I:9:DT:H1'	5:I:10:DC:H5'	1.88	0.55
6:J:35:DT:H2''	6:J:36:DA:O5'	2.07	0.55
6:J:36:DA:H2''	6:J:37:DG:C8	2.41	0.55
6:J:117:DA:H1'	6:J:118:DT:H5'	1.89	0.55
5:I:3:DC:N4	6:J:145:DG:H1	2.02	0.55
6:J:18:DG:H2'	6:J:19:DA:C8	2.41	0.55
5:I:94:DC:H1'	5:I:95:DC:H5''	1.88	0.54
7:K:608:ASN:HA	7:K:636:ARG:HH12	1.72	0.54
6:J:121:DA:H2''	6:J:122:DG:C8	2.42	0.54
3:C:65:GLU:HA	4:D:74:HIS:NE2	2.23	0.54
5:I:97:DA:H4'	5:I:98:DA:OP1	2.08	0.54
3:C:43:ARG:CZ	5:I:113:DA:H1'	2.36	0.54
4:H:90:PHE:O	4:H:94:ILE:HG12	2.08	0.54
7:K:552:LEU:HD21	7:K:618:TYR:HD2	1.72	0.54
7:K:262:LEU:HD21	7:K:309:THR:O	2.08	0.54
5:I:34:DG:H2''	5:I:35:DT:C5'	2.38	0.54
7:K:233:LYS:O	7:K:237:THR:HG23	2.08	0.54
6:J:134:DC:H2''	6:J:135:DC:C6	2.43	0.53
7:K:287:GLN:HA	7:K:290:GLU:HG2	1.90	0.53
7:K:440:LEU:HD11	7:K:636:ARG:O	2.09	0.53
7:K:588:ASP:HB3	7:K:591:SER:HB2	1.91	0.53
2:F:46:ILE:CG2	2:F:50:ILE:HG21	2.39	0.53
5:I:118:DC:H1'	5:I:119:DC:H5'	1.91	0.53
7:K:243:HIS:HA	7:K:245:LYS:HZ2	1.73	0.53
7:K:440:LEU:CD1	7:K:636:ARG:O	2.57	0.53
3:C:43:ARG:HB2	4:D:113:THR:HG22	1.90	0.53
1:E:117:VAL:HG12	1:E:117:VAL:O	2.08	0.53
6:J:108:DC:H2''	6:J:109:DT:C5	2.44	0.53
7:K:294:LYS:HE3	7:K:305:PRO:HG3	1.90	0.53
7:K:322:LEU:CD1	7:K:351:HIS:O	2.57	0.53
7:K:515:PRO:O	7:K:516:VAL:C	2.47	0.53

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
3:G:98:LEU:HG	3:G:101:VAL:HG21	1.91	0.53
7:K:456:GLN:OE1	7:K:523:CYS:HA	2.08	0.53
7:K:257:ALA:HB3	7:K:262:LEU:HD23	1.90	0.53
7:K:379:ILE:HG23	7:K:380:LEU:HD12	1.90	0.53
5:I:113:DA:H2'	5:I:114:DG:C8	2.44	0.52
6:J:15:DT:H1'	6:J:16:DC:C2	2.43	0.52
5:I:98:DA:H2''	5:I:99:DG:O5'	2.09	0.52
6:J:108:DC:H2''	6:J:109:DT:C6	2.45	0.52
7:K:621:ASP:OD2	7:K:627:ASP:OD1	2.27	0.52
7:K:460:GLN:O	7:K:464:VAL:HG23	2.10	0.52
7:K:605:LEU:O	7:K:636:ARG:NH2	2.43	0.52
6:J:14:DA:H4'	6:J:15:DT:OP1	2.09	0.52
5:I:115:DT:H2'	5:I:116:DC:C6	2.45	0.52
1:A:70:LEU:O	1:A:74:ILE:HG13	2.11	0.51
3:G:113:HIS:HB2	3:G:115:LEU:HD23	1.91	0.51
5:I:131:DA:H2'	5:I:132:DG:C5	2.45	0.51
7:K:333:ASP:HA	7:K:360:LEU:HD12	1.92	0.51
5:I:7:DA:H2''	5:I:8:DA:C8	2.45	0.51
6:J:14:DA:H1'	6:J:15:DT:C5	2.46	0.51
4:H:64:ILE:H	4:H:64:ILE:HD12	1.76	0.51
5:I:126:DG:H2'	5:I:126:DG:N3	2.25	0.50
7:K:221:LEU:HB3	7:K:427:PHE:CE1	2.45	0.50
3:G:71:ALA:O	3:G:72:ARG:C	2.55	0.50
5:I:88:DT:H6	5:I:88:DT:H5'	1.77	0.50
6:J:39:DG:H2''	6:J:40:DA:C8	2.46	0.50
3:C:98:LEU:HD11	4:D:90:PHE:CE1	2.47	0.50
4:D:81:SER:HB2	6:J:19:DA:OP2	2.12	0.50
1:E:51:ILE:O	1:E:55:GLN:HG3	2.10	0.50
5:I:21:DG:H2''	5:I:22:DG:O5'	2.11	0.50
5:I:129:DT:H2'	5:I:129:DT:O2	2.12	0.50
6:J:35:DT:H2''	6:J:36:DA:C8	2.47	0.50
7:K:244:LEU:O	7:K:245:LYS:C	2.53	0.50
2:B:95:ARG:NH2	1:E:99:TYR:HD1	2.10	0.50
4:H:64:ILE:HD12	4:H:64:ILE:N	2.26	0.50
5:I:111:DC:H2''	5:I:112:DT:C7	2.41	0.50
7:K:624:PRO:HD3	7:K:665:LYS:HD3	1.92	0.50
4:D:115:THR:OG1	4:D:116:SER:N	2.45	0.50
6:J:137:DG:H1'	6:J:138:DG:H5'	1.93	0.50
3:C:76:LYS:HE3	5:I:133:DA:H5''	1.93	0.49
5:I:24:DC:H2''	5:I:25:DG:C8	2.47	0.49
7:K:216:LEU:O	7:K:220:GLY:N	2.45	0.49

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
3:G:54:ALA:CB	4:H:139:GLY:HA2	2.42	0.49
3:G:78:ARG:NE	5:I:20:DA:H4'	2.28	0.49
7:K:570:ILE:HD13	7:K:579:ARG:HB2	1.94	0.49
5:I:24:DC:H2''	5:I:25:DG:N7	2.28	0.49
5:I:129:DT:H2'	5:I:130:DC:C5'	2.42	0.49
7:K:482:TRP:O	7:K:483:LYS:C	2.55	0.49
5:I:47:DC:H2''	5:I:48:DT:H71	1.94	0.49
6:J:139:DA:H2''	6:J:140:DT:OP2	2.11	0.49
7:K:440:LEU:HB3	7:K:441:PRO:HD2	1.94	0.49
3:G:80:VAL:HG22	3:G:83:HIS:ND1	2.28	0.49
1:E:107:THR:HG21	1:E:124:ILE:HG12	1.95	0.49
5:I:18:DC:H2''	5:I:19:DG:C8	2.48	0.49
5:I:98:DA:H2''	5:I:99:DG:O4'	2.13	0.49
7:K:300:VAL:HG13	7:K:304:PHE:HB3	1.94	0.49
7:K:542:LYS:HG2	7:K:594:SER:HA	1.94	0.49
4:H:115:THR:OG1	4:H:116:SER:N	2.44	0.49
5:I:88:DT:H2''	5:I:89:DA:O4'	2.13	0.49
6:J:21:DA:H2''	6:J:22:DC:C6	2.47	0.49
6:J:57:DG:H5'	6:J:57:DG:H8	1.77	0.48
6:J:133:DA:C4	6:J:134:DC:C5	3.01	0.48
1:A:86:SER:O	1:A:89:VAL:HG12	2.13	0.48
5:I:94:DC:H2''	5:I:95:DC:H5'	1.95	0.48
4:H:140:THR:O	4:H:141:LYS:C	2.55	0.48
5:I:14:DG:H2''	5:I:15:DT:C5'	2.43	0.48
5:I:5:DA:H1'	5:I:6:DG:H5'	1.95	0.48
7:K:544:LEU:N	7:K:614:THR:O	2.47	0.48
1:A:67:PHE:O	1:A:71:VAL:HG13	2.13	0.48
7:K:460:GLN:O	7:K:464:VAL:N	2.46	0.48
7:K:256:ILE:HG22	7:K:311:TYR:CE1	2.49	0.48
7:K:213:LEU:HD23	7:K:240:PHE:CB	2.44	0.47
7:K:601:ARG:NH1	7:K:626:MET:HG3	2.28	0.47
2:F:35:ARG:HD3	2:F:51:TYR:OH	2.14	0.47
5:I:102:DG:C6	5:I:103:DA:C6	3.02	0.47
5:I:79:DC:H2''	5:I:80:DC:C6	2.49	0.47
7:K:346:LEU:HD12	7:K:346:LEU:HA	1.72	0.47
5:I:129:DT:H2'	5:I:130:DC:H5''	1.96	0.47
7:K:516:VAL:O	7:K:517:GLU:HB3	2.13	0.47
3:G:96:LYS:HB2	3:G:96:LYS:NZ	2.30	0.47
4:D:111:LYS:HG2	4:D:113:THR:H	1.79	0.47
5:I:43:DA:H1'	5:I:44:DG:H5'	1.96	0.47
7:K:291:LEU:HD13	7:K:320:ARG:HD3	1.97	0.47

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
5:I:6:DG:H2''	5:I:7:DA:C8	2.50	0.47
6:J:53:DG:H2'	6:J:54:DG:N3	2.30	0.47
6:J:139:DA:H1'	6:J:140:DT:C5'	2.44	0.47
7:K:462:HIS:HB3	7:K:468:LEU:CA	2.44	0.47
6:J:69:DG:H2'	6:J:70:DG:O4'	2.14	0.47
7:K:214:ILE:HA	7:K:240:PHE:HE1	1.79	0.47
6:J:110:DA:H1'	6:J:111:DC:C6	2.50	0.46
7:K:268:GLU:O	7:K:271:ARG:HG2	2.15	0.46
6:J:38:DG:H2''	6:J:39:DG:C8	2.51	0.46
7:K:228:GLN:HG3	7:K:432:MET:HA	1.94	0.46
7:K:509:GLY:O	7:K:510:SER:C	2.58	0.46
5:I:2:DT:H1'	5:I:3:DC:O4'	2.15	0.46
5:I:126:DG:C2	6:J:23:DG:C2	3.03	0.46
7:K:238:ILE:HG13	7:K:268:GLU:OE1	2.16	0.46
1:E:125:GLN:O	1:E:129:ARG:HG3	2.16	0.46
7:K:200:GLY:O	7:K:201:GLN:HG3	2.15	0.46
2:B:50:ILE:HD11	1:E:119:ILE:HG23	1.98	0.46
7:K:318:ALA:O	7:K:319:LYS:C	2.59	0.46
1:E:68:GLN:O	1:E:71:VAL:HG22	2.16	0.46
3:G:31:ILE:HG23	4:H:95:PHE:HE2	1.80	0.46
5:I:102:DG:H3'	5:I:103:DA:C8	2.51	0.46
3:G:73:ASP:C	3:G:75:LYS:H	2.23	0.46
4:H:108:TYR:C	4:H:110:LYS:H	2.24	0.46
7:K:300:VAL:HG13	7:K:304:PHE:HB2	1.96	0.46
2:B:67:ARG:O	2:B:70:VAL:HG22	2.16	0.46
5:I:59:DA:H2''	5:I:60:DA:C8	2.51	0.46
5:I:99:DG:N2	5:I:100:DG:N3	2.64	0.46
6:J:56:DG:H1'	6:J:57:DG:H5''	1.98	0.46
7:K:279:ILE:HD13	7:K:294:LYS:HD3	1.97	0.46
6:J:90:DA:H1'	6:J:91:DA:C8	2.50	0.45
7:K:425:ARG:N	7:K:426:PRO:HD2	2.31	0.45
5:I:36:DC:H2''	5:I:37:DG:H5''	1.99	0.45
6:J:102:DA:H2''	6:J:103:DG:H5'	1.99	0.45
7:K:365:LEU:HD11	7:K:372:LEU:CD1	2.46	0.45
7:K:459:PHE:HE2	7:K:500:PRO:HB2	1.76	0.45
7:K:654:ILE:O	7:K:658:VAL:HG23	2.16	0.45
4:D:116:SER:O	4:D:117:ARG:C	2.57	0.45
4:H:81:SER:C	4:H:83:ALA:H	2.23	0.45
7:K:256:ILE:HG22	7:K:311:TYR:CD1	2.51	0.45
7:K:380:LEU:HD11	7:K:427:PHE:CE1	2.51	0.45
7:K:547:SER:OG	7:K:548:GLN:N	2.49	0.45

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
5:I:5:DA:OP1	5:I:5:DA:H2'	2.16	0.45
5:I:121:DG:H1	6:J:26:DC:N4	2.05	0.45
7:K:609:LEU:HD12	7:K:609:LEU:O	2.16	0.45
2:B:26:ILE:HG22	1:E:70:LEU:CD1	2.46	0.45
5:I:97:DA:H1'	5:I:98:DA:C8	2.51	0.45
6:J:132:DC:H2''	6:J:133:DA:C8	2.52	0.45
6:J:138:DG:H1'	6:J:139:DA:H5'	1.99	0.45
7:K:627:ASP:O	7:K:631:MET:HG3	2.17	0.45
5:I:101:DG:C2	5:I:102:DG:C1'	2.94	0.45
6:J:16:DC:H2''	6:J:17:DT:OP2	2.17	0.45
6:J:130:DG:H2''	6:J:131:DG:N7	2.32	0.45
7:K:366:GLN:HB3	7:K:625:GLN:HG3	1.99	0.45
5:I:4:DG:H2''	5:I:5:DA:C8	2.52	0.45
5:I:8:DA:C2'	5:I:9:DT:H71	2.47	0.45
7:K:516:VAL:C	7:K:518:GLU:H	2.24	0.45
3:G:81:PRO:O	3:G:84:ILE:HG12	2.17	0.45
7:K:262:LEU:HD22	7:K:308:ILE:CG2	2.47	0.45
7:K:481:GLY:O	7:K:482:TRP:C	2.58	0.45
3:C:72:ARG:CZ	4:D:74:HIS:HD1	2.30	0.45
1:E:65:LEU:O	1:E:69:ARG:HG3	2.17	0.45
5:I:89:DA:C2	5:I:90:DA:C4	3.05	0.45
7:K:469:GLU:O	7:K:473:GLY:N	2.50	0.44
1:A:102:GLY:O	1:A:105:GLU:HG2	2.16	0.44
2:B:62:LEU:HD21	1:E:67:PHE:CZ	2.53	0.44
3:C:63:VAL:HG12	4:D:87:MET:HE1	1.98	0.44
5:I:89:DA:H2''	5:I:90:DA:O4'	2.17	0.44
6:J:134:DC:H2''	6:J:135:DC:H5''	1.99	0.44
6:J:137:DG:C4	6:J:138:DG:C8	3.05	0.44
7:K:465:ASN:CG	7:K:466:ASN:H	2.24	0.44
2:B:73:THR:O	2:B:74:GLU:C	2.59	0.44
3:C:46:ALA:O	3:C:49:PRO:HD2	2.17	0.44
7:K:516:VAL:C	7:K:518:GLU:N	2.74	0.44
7:K:588:ASP:CG	7:K:591:SER:H	2.26	0.44
7:K:252:PRO:HD2	7:K:328:LYS:HG2	1.98	0.44
7:K:478:ARG:HB2	7:K:509:GLY:HA3	1.98	0.44
1:E:103:LEU:O	1:E:107:THR:HG23	2.18	0.44
7:K:228:GLN:O	7:K:230:GLY:N	2.51	0.44
7:K:520:VAL:HG21	7:K:559:TYR:HD1	1.81	0.44
1:A:130:ILE:CG2	1:E:131:ARG:HG3	2.48	0.44
5:I:16:DG:N2	6:J:133:DA:C6	2.86	0.44
1:A:49:ARG:HA	1:A:52:ARG:NH2	2.33	0.44

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
5:I:3:DC:H1'	5:I:4:DG:O4'	2.18	0.44
5:I:82:DC:H2''	5:I:83:DG:C8	2.52	0.44
5:I:130:DC:H2''	5:I:131:DA:C8	2.53	0.44
1:A:69:ARG:HG2	2:F:25:ASN:CG	2.43	0.44
1:A:73:GLU:HB2	2:F:25:ASN:HD22	1.83	0.44
2:F:26:ILE:C	2:F:28:GLY:N	2.75	0.44
7:K:552:LEU:HD21	7:K:618:TYR:CE2	2.53	0.44
7:K:231:LEU:HB2	7:K:436:VAL:HG21	2.00	0.43
7:K:380:LEU:HD21	7:K:427:PHE:CZ	2.54	0.43
5:I:8:DA:H1'	5:I:9:DT:H5'	1.99	0.43
7:K:216:LEU:HD21	7:K:223:GLY:N	2.33	0.43
7:K:607:ILE:CG2	7:K:609:LEU:HG	2.48	0.43
5:I:39:DA:C2	5:I:40:DG:C4	3.05	0.43
5:I:100:DG:N1	6:J:49:DC:O2	2.52	0.43
7:K:326:PRO:HB3	7:K:355:ASP:OD2	2.18	0.43
5:I:48:DT:H2''	5:I:49:DA:C8	2.53	0.43
6:J:20:DC:N4	6:J:21:DA:N6	2.66	0.43
6:J:70:DG:H2'	6:J:71:DA:C8	2.53	0.43
6:J:120:DG:H2''	6:J:121:DA:N7	2.33	0.43
7:K:624:PRO:O	7:K:628:LEU:HG	2.19	0.43
5:I:34:DG:H2'	5:I:35:DT:H71	2.00	0.43
7:K:271:ARG:HD3	7:K:271:ARG:HA	1.82	0.43
7:K:380:LEU:HD11	7:K:427:PHE:CZ	2.54	0.43
1:E:117:VAL:O	1:E:117:VAL:CG1	2.67	0.43
4:H:114:ILE:HA	4:H:118:GLU:OE1	2.19	0.43
5:I:39:DA:N1	6:J:109:DT:O2	2.52	0.43
5:I:101:DG:N2	6:J:48:DC:O2	2.52	0.43
5:I:128:DG:C2	6:J:21:DA:N3	2.86	0.43
6:J:46:DC:OP2	6:J:46:DC:H2'	2.19	0.43
7:K:244:LEU:HB3	7:K:248:GLY:O	2.19	0.43
7:K:468:LEU:O	7:K:472:LEU:HD13	2.18	0.43
5:I:103:DA:H8	5:I:103:DA:OP2	2.02	0.42
6:J:53:DG:H3'	6:J:54:DG:N2	2.33	0.42
6:J:135:DC:H2''	6:J:136:DG:N7	2.34	0.42
1:A:92:LEU:HD12	1:A:92:LEU:HA	1.87	0.42
4:H:132:ALA:O	4:H:133:LYS:C	2.59	0.42
6:J:57:DG:H5'	6:J:57:DG:C8	2.54	0.42
6:J:141:DT:H2''	6:J:142:DC:C5	2.55	0.42
1:A:63:ARG:HG3	5:I:91:DC:OP1	2.19	0.42
2:B:82:THR:OG1	2:B:83:ALA:N	2.50	0.42
7:K:261:THR:O	7:K:265:TRP:CD1	2.70	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:E:107:THR:HG22	1:E:124:ILE:HA	2.00	0.42
5:I:40:DG:C6	5:I:41:DA:C6	3.07	0.42
5:I:120:DA:H2'	5:I:121:DG:C8	2.54	0.42
7:K:349:LEU:HG	7:K:354:MET:HE1	2.02	0.42
2:F:26:ILE:C	2:F:28:GLY:H	2.27	0.42
3:G:103:ILE:HD12	3:G:103:ILE:H	1.84	0.42
7:K:601:ARG:HH12	7:K:626:MET:HG3	1.84	0.42
1:E:106:ASP:OD1	1:E:107:THR:N	2.53	0.42
2:F:76:ALA:O	2:F:77:ARG:HB2	2.20	0.42
3:G:43:ARG:O	4:H:113:THR:HA	2.19	0.42
6:J:29:DG:C6	6:J:30:DG:C6	3.08	0.42
6:J:143:DT:H2''	6:J:144:DC:C6	2.55	0.42
4:D:141:LYS:O	4:D:144:THR:OG1	2.38	0.42
5:I:8:DA:H2'	5:I:9:DT:H71	2.01	0.42
7:K:251:GLY:H	7:K:300:VAL:CG1	2.30	0.42
7:K:375:LEU:O	7:K:378:PHE:N	2.53	0.42
3:G:59:LEU:HD13	4:H:94:ILE:HG21	2.02	0.42
6:J:134:DC:H2''	6:J:135:DC:O4'	2.20	0.42
7:K:202:LEU:HB3	7:K:203:LYS:H	1.73	0.42
7:K:452:MET:HG3	7:K:456:GLN:HB2	2.02	0.42
7:K:553:LEU:HD23	7:K:553:LEU:HA	1.94	0.42
3:G:103:ILE:HD12	3:G:103:ILE:N	2.35	0.42
5:I:91:DC:OP1	5:I:91:DC:H4'	2.19	0.42
6:J:116:DA:H2''	6:J:117:DA:C8	2.55	0.42
6:J:131:DG:H2''	6:J:132:DC:C5	2.55	0.42
7:K:653:SER:OG	7:K:654:ILE:N	2.53	0.42
1:A:76:GLN:HB2	7:K:483:LYS:O	2.20	0.41
3:G:74:ASN:ND2	3:G:76:LYS:HE2	2.35	0.41
5:I:123:DC:H2'	5:I:124:DA:C8	2.55	0.41
6:J:53:DG:H4'	6:J:54:DG:OP1	2.20	0.41
5:I:111:DC:N4	6:J:36:DA:N1	2.68	0.41
5:I:91:DC:H42	6:J:57:DG:H1	1.66	0.41
7:K:352:LEU:HB2	7:K:354:MET:HE3	2.02	0.41
1:A:63:ARG:HG3	5:I:91:DC:P	2.61	0.41
5:I:111:DC:N4	6:J:37:DG:H1	2.08	0.41
7:K:330:VAL:HG12	7:K:332:ILE:HD11	2.03	0.41
5:I:20:DA:O5'	5:I:20:DA:H8	2.04	0.41
6:J:130:DG:H2''	6:J:131:DG:C8	2.55	0.41
7:K:380:LEU:HD21	7:K:427:PHE:CE1	2.55	0.41
7:K:481:GLY:HA2	7:K:507:ILE:HA	2.02	0.41
7:K:576:LEU:O	7:K:579:ARG:HG2	2.20	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:F:40:ARG:NH2	3:G:107:GLY:HA2	2.35	0.41
4:H:61:THR:OG1	4:H:63:LYS:HG3	2.21	0.41
7:K:551:LYS:O	7:K:554:ASP:HB2	2.21	0.41
2:B:66:ILE:HD11	1:E:71:VAL:HB	2.03	0.41
3:C:80:VAL:HG13	3:C:81:PRO:HD2	2.02	0.41
3:C:103:ILE:HG23	4:D:86:ILE:HD12	2.02	0.41
4:D:105:LEU:HD23	4:D:105:LEU:HA	1.90	0.41
5:I:13:DG:H2'	5:I:14:DG:C8	2.56	0.41
5:I:20:DA:C6	5:I:21:DG:C6	3.09	0.41
6:J:77:DC:H2''	6:J:78:DG:C8	2.55	0.41
7:K:249:LEU:HD23	7:K:249:LEU:H	1.85	0.41
2:B:47:SER:H	2:B:50:ILE:CD1	2.30	0.41
3:G:48:ALA:HB3	3:G:49:PRO:HD3	2.03	0.41
3:G:73:ASP:C	3:G:75:LYS:N	2.77	0.41
5:I:3:DC:C2'	5:I:4:DG:C8	3.04	0.41
6:J:47:DC:H2''	6:J:48:DC:C5	2.56	0.41
6:J:93:DC:H2''	6:J:94:DG:H8	1.86	0.41
7:K:258:PRO:O	7:K:262:LEU:HG	2.21	0.41
7:K:463:LEU:HD12	7:K:463:LEU:HA	1.91	0.41
2:B:71:THR:O	2:B:72:TYR:C	2.62	0.41
3:C:107:GLY:HA3	1:E:58:THR:HG22	2.04	0.41
4:H:131:LEU:O	4:H:132:ALA:C	2.64	0.41
5:I:78:DC:H2''	5:I:79:DC:C5	2.56	0.41
5:I:128:DG:C6	6:J:21:DA:C2	3.09	0.40
3:C:98:LEU:HD11	4:D:90:PHE:HE1	1.84	0.40
3:G:43:ARG:O	4:H:113:THR:HG23	2.21	0.40
5:I:101:DG:H2'	5:I:102:DG:O4'	2.21	0.40
5:I:115:DT:H2'	5:I:116:DC:H6	1.84	0.40
6:J:18:DG:C2	6:J:19:DA:C4	3.08	0.40
7:K:223:GLY:O	7:K:358:LEU:HD12	2.21	0.40
7:K:316:ASN:OD1	7:K:317:ASP:N	2.55	0.40
7:K:520:VAL:HG21	7:K:559:TYR:CD1	2.55	0.40
5:I:37:DG:C8	5:I:37:DG:H5'	2.56	0.40
6:J:30:DG:H1'	6:J:31:DA:H5'	2.03	0.40
5:I:38:DT:H2''	5:I:39:DA:H8	1.83	0.40
5:I:88:DT:H2''	5:I:89:DA:O5'	2.22	0.40
5:I:127:DT:N3	6:J:21:DA:C2	2.87	0.40
7:K:207:LEU:O	7:K:211:LYS:HG3	2.21	0.40
7:K:303:LYS:O	7:K:304:PHE:C	2.63	0.40
5:I:36:DC:C2'	5:I:37:DG:H5''	2.52	0.40
6:J:116:DA:H2''	6:J:117:DA:H8	1.87	0.40

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
6:J:132:DC:C4	6:J:133:DA:N6	2.90	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	92/136 (68%)	87 (95%)	4 (4%)	1 (1%)	12	45
1	E	83/136 (61%)	78 (94%)	5 (6%)	0	100	100
2	B	75/103 (73%)	72 (96%)	3 (4%)	0	100	100
2	F	85/103 (82%)	81 (95%)	4 (5%)	0	100	100
3	C	86/130 (66%)	82 (95%)	4 (5%)	0	100	100
3	G	97/130 (75%)	92 (95%)	5 (5%)	0	100	100
4	D	87/150 (58%)	83 (95%)	3 (3%)	1 (1%)	12	45
4	H	90/150 (60%)	80 (89%)	10 (11%)	0	100	100
7	K	441/765 (58%)	388 (88%)	46 (10%)	7 (2%)	8	37
All	All	1136/1803 (63%)	1043 (92%)	84 (7%)	9 (1%)	19	51

All (9) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
7	K	258	PRO
1	A	62	ILE
7	K	245	LYS
7	K	483	LYS
7	K	440	LEU
4	D	110	LYS
7	K	222	ASN

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Mol	Chain	Res	Type
7	K	482	TRP
7	K	514	PRO

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	A	80/109 (73%)	80 (100%)	0	100	100
1	E	73/109 (67%)	73 (100%)	0	100	100
2	B	63/79 (80%)	63 (100%)	0	100	100
2	F	72/79 (91%)	72 (100%)	0	100	100
3	C	64/95 (67%)	64 (100%)	0	100	100
3	G	75/95 (79%)	73 (97%)	2 (3%)	40	65
4	D	78/124 (63%)	77 (99%)	1 (1%)	65	82
4	H	81/124 (65%)	81 (100%)	0	100	100
7	K	398/678 (59%)	392 (98%)	6 (2%)	60	79
All	All	984/1492 (66%)	975 (99%)	9 (1%)	74	87

All (9) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
4	D	105	LEU
3	G	75	LYS
3	G	96	LYS
7	K	269	ILE
7	K	294	LYS
7	K	433	LYS
7	K	457	LYS
7	K	544	LEU
7	K	584	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (5) such sidechains are listed below:

Mol	Chain	Res	Type
3	C	105	ASN
4	D	88	ASN
4	H	74	HIS
7	K	228	GLN
7	K	629	GLN

5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains [i](#)

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](#)

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.