



# wwPDB X-ray Structure Validation Summary Report ⓘ

Feb 1, 2016 – 07:30 AM GMT

PDB ID : 3AZM  
Title : Crystal Structure of Human Nucleosome Core Particle Containing H4K79Q mutation  
Authors : Iwasaki, W.; Tachiwana, H.; Kawaguchi, K.; Shibata, T.; Kagawa, W.; Kurumizaka, H.  
Deposited on : 2011-05-25  
Resolution : 2.89 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](mailto:validation@mail.wwpdb.org)  
A user guide is available at  
<http://wwpdb.org/validation/2016/XrayValidationReportHelp>  
with specific help available everywhere you see the ⓘ symbol.

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The following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4.02b-467  
Mogul : 1.7 (RC4), CSD as536be (2015)  
Xtriage (Phenix) : 1.9-1692  
EDS : rb-20026688  
Percentile statistics : 20151230.v01 (using entries in the PDB archive December 30th 2015)  
Refmac : 5.8.0135  
CCP4 : 6.5.0  
Ideal geometry (proteins) : Engh & Huber (2001)  
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)  
Validation Pipeline (wwPDB-VP) : trunk26865

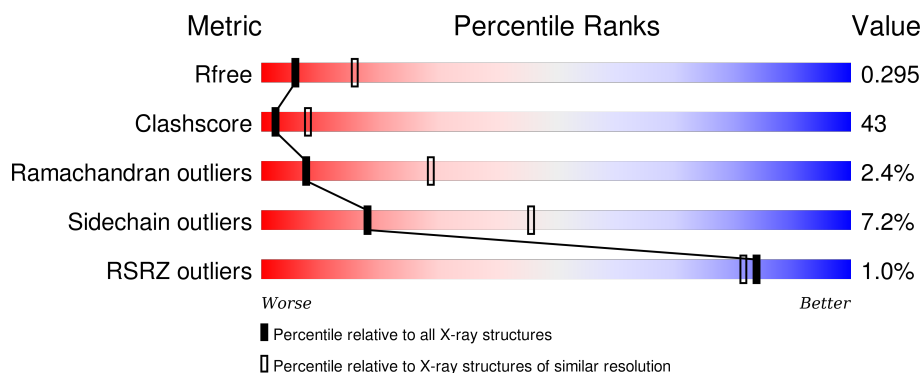
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 2.89 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))
$R_{free}$	91344	1451 (2.90-2.90)
Clashscore	102246	1668 (2.90-2.90)
Ramachandran outliers	100387	1630 (2.90-2.90)
Sidechain outliers	100360	1632 (2.90-2.90)
RSRZ outliers	91569	1456 (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 on the lower bar indicate the fraction of residues that contain outliers for  $\geq 3$ , 2, 1 and 0 types of geometric quality criteria. 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	139	<div> <div>27%</div> <div>40%</div> <div>•</div> <div>29%</div> </div>
1	E	139	<div> <div>35%</div> <div>32%</div> <div>•</div> <div>29%</div> </div>
2	B	106	<div> <div>2%</div> <div>34%</div> <div>35%</div> <div>•</div> <div>27%</div> </div>
2	F	106	<div> <div>26%</div> <div>46%</div> <div>7%</div> <div>21%</div> </div>
3	C	133	<div> <div>2%</div> <div>36%</div> <div>38%</div> <div>6%</div> <div>20%</div> </div>

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Mol	Chain	Length	Quality of chain
3	G	133	
4	D	129	
4	H	129	
5	I	146	
5	J	146	

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
7	MN	E	1001	-	-	-	X

## 2 Entry composition

There are 7 unique types of molecules in this entry. The entry contains 11947 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 Histone H3.1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	98	Total	C	N	O	S	0	0	0
			807	508	156	139	4			
1	E	99	Total	C	N	O	S	0	0	0
			816	514	158	140	4			

There are 6 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-3	GLY	-	EXPRESSION TAG	UNP P68431
A	-2	SER	-	EXPRESSION TAG	UNP P68431
A	-1	HIS	-	EXPRESSION TAG	UNP P68431
E	-3	GLY	-	EXPRESSION TAG	UNP P68431
E	-2	SER	-	EXPRESSION TAG	UNP P68431
E	-1	HIS	-	EXPRESSION TAG	UNP P68431

- Molecule 2 is a protein called Histone H4.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	77	Total	C	N	O	S	0	0	0
			614	388	119	106	1			
2	F	84	Total	C	N	O	S	0	0	0
			673	423	133	116	1			

There are 8 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	-3	GLY	-	EXPRESSION TAG	UNP P62805
B	-2	SER	-	EXPRESSION TAG	UNP P62805
B	-1	HIS	-	EXPRESSION TAG	UNP P62805
B	79	GLN	LYS	ENGINEERED MUTATION	UNP P62805
F	-3	GLY	-	EXPRESSION TAG	UNP P62805
F	-2	SER	-	EXPRESSION TAG	UNP P62805

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Chain	Residue	Modelled	Actual	Comment	Reference
F	-1	HIS	-	EXPRESSION TAG	UNP P62805
F	79	GLN	LYS	ENGINEERED MUTATION	UNP P62805

- Molecule 3 is a protein called Histone H2A type 1-B/E.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
3	C	106	Total	C	N	O	0	0	0
			819	517	160	142			
3	G	104	Total	C	N	O	0	0	0
			805	508	157	140			

There are 6 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
C	-3	GLY	-	EXPRESSION TAG	UNP P04908
C	-2	SER	-	EXPRESSION TAG	UNP P04908
C	-1	HIS	-	EXPRESSION TAG	UNP P04908
G	-3	GLY	-	EXPRESSION TAG	UNP P04908
G	-2	SER	-	EXPRESSION TAG	UNP P04908
G	-1	HIS	-	EXPRESSION TAG	UNP P04908

- Molecule 4 is a protein called Histone H2B type 1-J.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
4	D	95	Total	C	N	O	S	0	0	0
			745	468	136	139	2			
4	H	92	Total	C	N	O	S	0	0	0
			719	453	129	135	2			

There are 6 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
D	-3	GLY	-	EXPRESSION TAG	UNP P06899
D	-2	SER	-	EXPRESSION TAG	UNP P06899
D	-1	HIS	-	EXPRESSION TAG	UNP P06899
H	-3	GLY	-	EXPRESSION TAG	UNP P06899
H	-2	SER	-	EXPRESSION TAG	UNP P06899
H	-1	HIS	-	EXPRESSION TAG	UNP P06899

- Molecule 5 is a DNA chain called 146-MER DNA.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
5	I	145	Total	C	N	O	P	0	0	0
			2970	1421	538	867	144			
5	J	145	Total	C	N	O	P	0	0	0
			2969	1421	535	869	144			

- Molecule 6 is CHLORIDE ION (three-letter code: CL) (formula: Cl).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	G	1	Total	Cl	0	0
			1	1		
6	A	1	Total	Cl	0	0
			1	1		
6	C	1	Total	Cl	0	0
			1	1		

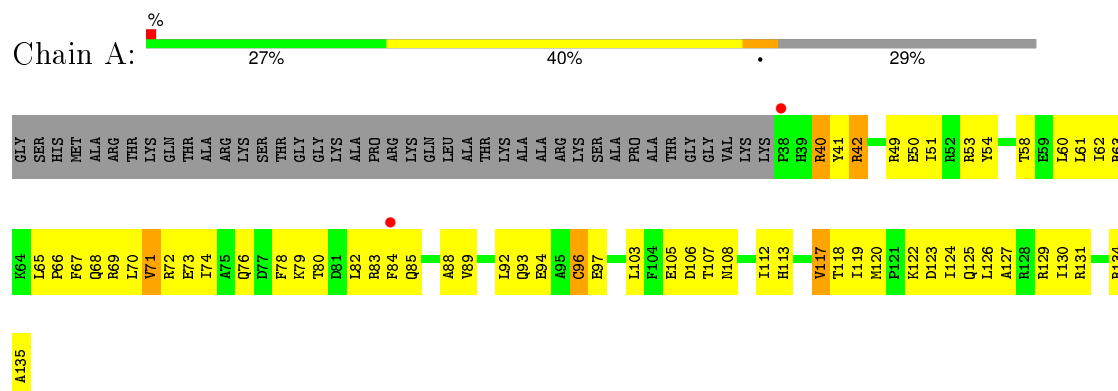
- Molecule 7 is MANGANESE (II) ION (three-letter code: MN) (formula: Mn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	J	3	Total	Mn	0	0
			3	3		
7	I	3	Total	Mn	0	0
			3	3		
7	E	1	Total	Mn	0	0
			1	1		

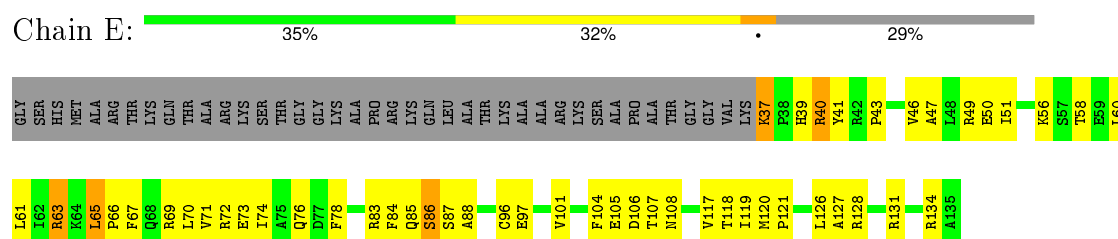
### 3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of errors 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 ( $\text{RSRZ} > 2$ ). 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.

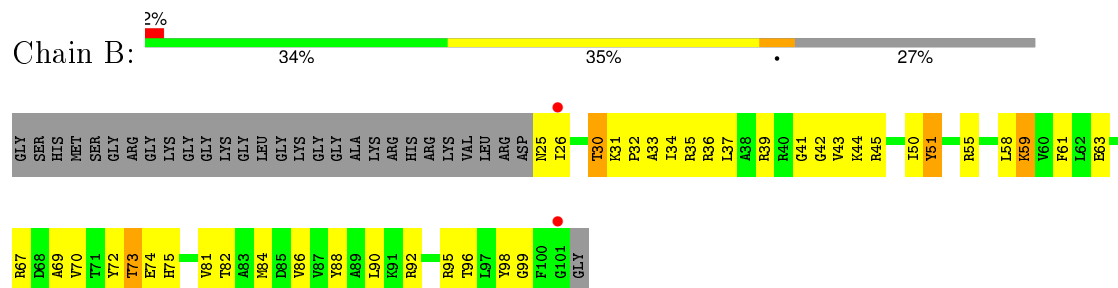
#### • Molecule 1: Histone H3.1



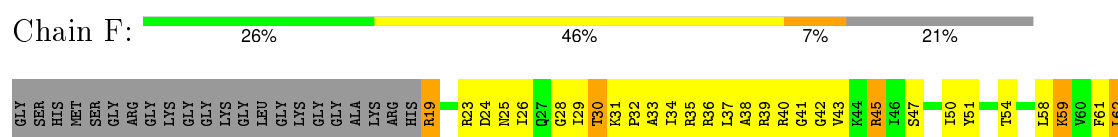
#### • Molecule 1: Histone H3.1

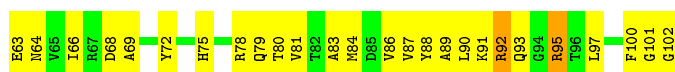


#### • Molecule 2: Histone H4

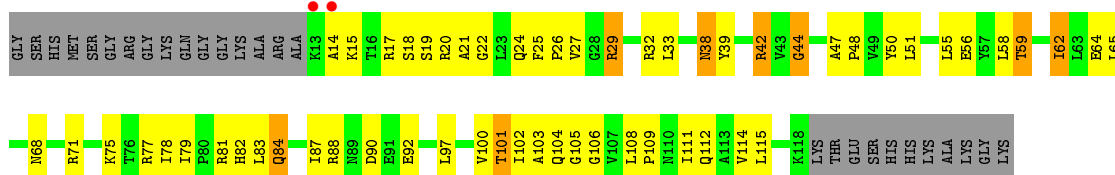


#### • Molecule 2: Histone H4

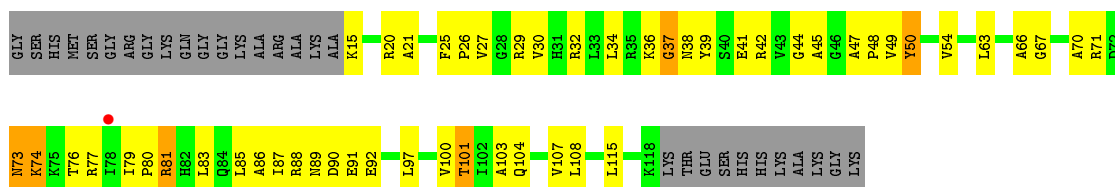




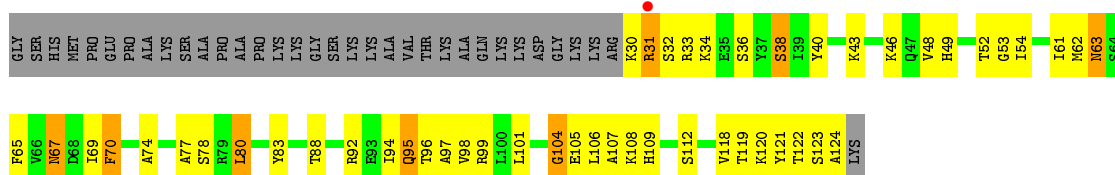
• Molecule 3: Histone H2A type 1-B/E



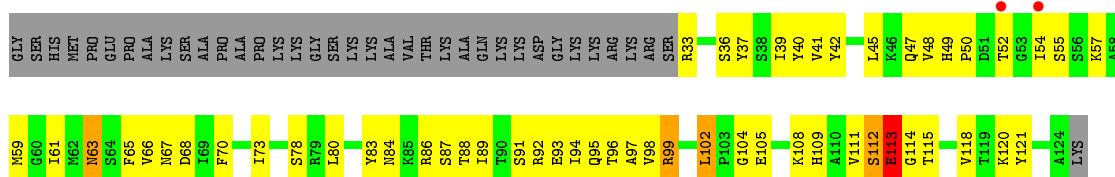
• Molecule 3: Histone H2A type 1-B/E



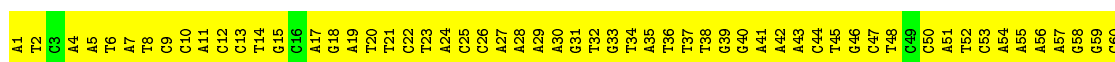
• Molecule 4: Histone H2B type 1-J



• Molecule 4: Histone H2B type 1-J



• Molecule 5: 146-MER DNA

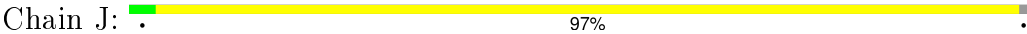




A61	A62	A63	A64	A65	A66	A67	A68	A69	A70	A71	A72	A73	A74	A75	A76	A77	A78	A79	A80	A81	A82	A83	A84	A85	A86	A87	A88	A89	A90	A91	A92	A93	A94	A95	A96	A97	A98	A99	G100	G101	G102	G103	G104	G105	G106	G107	G108	G109	G110	G111	G112	G113	G114	G115	G116	G117	G118	G119	G120	G121	G122	G123
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A124	A125	A126	A127	A128	A129	A130	A131	A132	A133	A134	A135	A136	A137	A138	A139	A140	A141	A142	A143	A144	A145	DT
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● Molecule 5: 146-MER DNA



DA	T148	T149	A150	A151	T152	A153	T154	C155	C156	A157	C158	C159	T160	G161	C162	A163	G164	A165	T166	T167	C168	T169	A170	C171	C172	A173	A174	A175	A176	G177	T178	G179	T180	A181	T182	T183	T184	G185	G186	A187	A188	A189	C190	T191	G192	C193	T194	C195	C196	A197	T198	A199	A200	A201	A202	A203	G204	G205	C206
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A207	T208	G209	T210	T211	C212	A213	G214	C215	T216	G217	A218	A219	T220	T221	C222	A223	G224	C225	T226	G227	A228	A229	C230	A231	T232	G233	C234	C235	T236	T237	T238	T239	G240	A241	T242	G243	G244	A245	G246	C247	A248	G249	T250	T251	T252	C253	C254	A255	A256	A257	T258	A259	C260	A261	C262	T263	T264	T265	T266
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G267	G268	T269	A270	G271	A272	A273	T274	C275	T276	G277	C278	A279	G280	G281	T282	G283	G284	A285	T286	A287	T288	G289	A290	A291	T292
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## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	104.79Å 108.77Å 174.51Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	41.52 – 2.89 41.52 – 2.89	Depositor EDS
% Data completeness (in resolution range)	99.3 (41.52-2.89) 99.2 (41.52-2.89)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	0.09	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	3.03 (at 2.90Å)	Xtriage
Refinement program	CNS 1.2	Depositor
R, $R_{free}$	0.241 , 0.296 0.240 , 0.295	Depositor DCC
$R_{free}$ test set	2262 reflections (5.05%)	DCC
Wilson B-factor (Å <sup>2</sup> )	69.4	Xtriage
Anisotropy	0.827	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.26 , 66.8	EDS
Estimated twinning fraction	0.023 for k,h,-l	Xtriage
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.47$ , $\langle L^2 \rangle = 0.29$	Xtriage
Outliers	0 of 44834 reflections	Xtriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	11947	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	104.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.81% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical values of  $\langle |L| \rangle$ ,  $\langle L^2 \rangle$  for acentric reflections are 0.5, 0.375 respectively for untwinned datasets, and 0.333, 0.2 for perfectly twinned datasets.

## 5 Model quality ⓘ

### 5.1 Standard geometry ⓘ

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

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	0.45	0/819	0.61	0/1097
1	E	0.52	0/828	0.71	0/1109
2	B	0.44	0/621	0.65	0/833
2	F	0.52	0/680	0.79	0/909
3	C	0.47	0/829	0.70	0/1118
3	G	0.42	0/815	0.66	0/1100
4	D	0.49	0/756	0.68	0/1015
4	H	0.44	0/730	0.64	0/982
5	I	0.41	0/3332	0.78	0/5141
5	J	0.38	0/3330	0.78	0/5138
All	All	0.43	0/12740	0.74	0/18442

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	807	0	844	78	0
1	E	816	0	856	73	0
2	B	614	0	651	71	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	F	673	0	717	84	0
3	C	819	0	879	73	0
3	G	805	0	861	60	0
4	D	745	0	771	62	0
4	H	719	0	740	66	0
5	I	2970	0	1640	240	0
5	J	2969	0	1641	291	0
6	A	1	0	0	0	0
6	C	1	0	0	1	0
6	G	1	0	0	0	0
7	E	1	0	0	0	0
7	I	3	0	0	0	0
7	J	3	0	0	0	0
All	All	11947	0	9600	923	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 43.

The worst 5 of 923 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)
2:F:19:ARG:HA	2:F:19:ARG:NH1	1.57	1.19
3:C:15:LYS:HB2	3:C:20:ARG:HH12	1.10	1.12
5:I:135:DG:H2''	5:I:136:DT:H5'	1.30	1.12
5:J:253:DC:H2''	5:J:254:DC:H5'	1.33	1.11
5:I:105:DT:H2''	5:I:106:DT:H5''	1.31	1.10

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 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	96/139 (69%)	84 (88%)	10 (10%)	2 (2%)	9	32
1	E	97/139 (70%)	84 (87%)	11 (11%)	2 (2%)	9	32
2	B	75/106 (71%)	64 (85%)	9 (12%)	2 (3%)	6	25
2	F	82/106 (77%)	61 (74%)	18 (22%)	3 (4%)	4	17
3	C	104/133 (78%)	90 (86%)	12 (12%)	2 (2%)	10	35
3	G	102/133 (77%)	85 (83%)	15 (15%)	2 (2%)	9	33
4	D	93/129 (72%)	78 (84%)	13 (14%)	2 (2%)	8	31
4	H	90/129 (70%)	72 (80%)	15 (17%)	3 (3%)	5	20
All	All	739/1014 (73%)	618 (84%)	103 (14%)	18 (2%)	7	29

5 of 18 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	71	VAL
2	F	30	THR
2	F	101	GLY
3	C	38	ASN
4	D	104	GLY

### 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	85/113 (75%)	81 (95%)	4 (5%)	32	68
1	E	86/113 (76%)	83 (96%)	3 (4%)	43	78
2	B	63/81 (78%)	60 (95%)	3 (5%)	31	67
2	F	69/81 (85%)	61 (88%)	8 (12%)	7	20
3	C	84/102 (82%)	75 (89%)	9 (11%)	8	24
3	G	83/102 (81%)	79 (95%)	4 (5%)	31	67
4	D	81/107 (76%)	72 (89%)	9 (11%)	8	22
4	H	78/107 (73%)	73 (94%)	5 (6%)	22	53

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
All	All	629/806 (78%)	584 (93%)	45 (7%)	18	46

5 of 45 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
4	D	67	ASN
1	E	37	LYS
4	H	99	ARG
4	D	80	LEU
1	E	63	ARG

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 19 such sidechains are listed below:

Mol	Chain	Res	Type
3	C	84	GLN
4	D	84	ASN
2	F	75	HIS
3	C	73	ASN
2	F	93	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 carbohydrates in this entry.

## 5.6 Ligand geometry [i](#)

Of 10 ligands modelled in this entry, 10 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

There are no such residues in this entry.

## 5.8 Polymer linkage issues

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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	98/139 (70%)	0.00	2 (2%) 68 64	40, 79, 109, 137	0
1	E	99/139 (71%)	-0.18	0 100 100	38, 63, 88, 131	0
2	B	77/106 (72%)	0.02	2 (2%) 59 54	50, 73, 92, 113	0
2	F	84/106 (79%)	-0.12	0 100 100	39, 58, 73, 113	0
3	C	106/133 (79%)	-0.10	2 (1%) 70 66	46, 64, 98, 128	0
3	G	104/133 (78%)	-0.06	1 (0%) 84 82	50, 75, 108, 121	0
4	D	95/129 (73%)	-0.06	1 (1%) 82 80	46, 67, 103, 157	0
4	H	92/129 (71%)	-0.00	2 (2%) 65 60	46, 75, 101, 126	0
5	I	145/146 (99%)	-0.23	0 100 100	73, 134, 174, 191	0
5	J	145/146 (99%)	-0.22	0 100 100	80, 136, 182, 201	0
All	All	1045/1306 (80%)	-0.11	10 (0%) 84 82	38, 77, 162, 201	0

The worst 5 of 10 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
4	H	52	THR	3.6
4	D	31	ARG	3.3
2	B	26	ILE	2.9
1	A	38	PRO	2.9
3	C	14	ALA	2.8

### 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 ⓘ

There are no carbohydrates in this entry.

### 6.4 Ligands ⓘ

In the following table, the Atoms column lists the number of modelled atoms in the group and the number defined in the chemical component dictionary. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. The B-factors column lists the minimum, median, 95<sup>th</sup> percentile and maximum values of B factors of atoms in the group. The column labelled 'Q< 0.9' lists the number of atoms with occupancy less than 0.9.

Mol	Type	Chain	Res	Atoms	RSCC	RSR	LLDF	B-factors(Å <sup>2</sup> )	Q<0.9
7	MN	E	1001	1/1	0.97	0.29	4.52	61,61,61,61	0
6	CL	C	1001	1/1	0.98	0.07	-2.66	87,87,87,87	0
6	CL	G	1001	1/1	0.94	0.09	-2.80	74,74,74,74	0
7	MN	J	1003	1/1	0.92	0.07	-	118,118,118,118	0
7	MN	I	1002	1/1	0.92	0.06	-	123,123,123,123	0
7	MN	J	1001	1/1	0.96	0.05	-	137,137,137,137	0
7	MN	I	1003	1/1	0.78	0.22	-	119,119,119,119	0
7	MN	I	1001	1/1	0.82	0.09	-	137,137,137,137	0
7	MN	J	1002	1/1	0.92	0.22	-	122,122,122,122	0
6	CL	A	1001	1/1	0.87	0.10	-	85,85,85,85	0

### 6.5 Other polymers ⓘ

There are no such residues in this entry.