



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 6, 2026 – 09:35 AM UTC

PDB ID : 6M44 / pdb_00006m44
Title : 355 bp di-nucleosome harboring cohesive DNA termini (high cryoprotectant)
Authors : Adhireksan, Z.; Sharma, D.; Lee, P.L.; Davey, C.A.
Deposited on : 2020-03-05
Resolution : 3.81 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

A user guide is available at

<https://www.wwpdb.org/validation/2017/XrayValidationReportHelp>

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:

MolProbity	:	4-5-2 with Phenix2.0
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

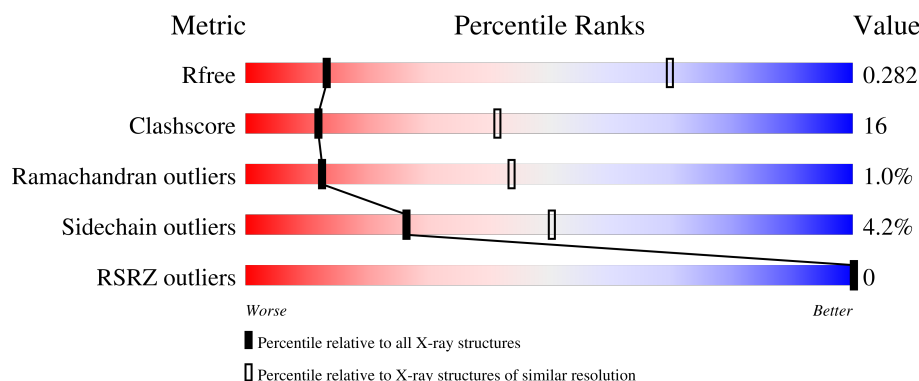
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.81 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.



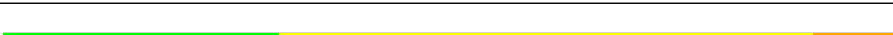
Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	180053	1043 (3.98-3.66)
Clashscore	190562	1075 (3.98-3.66)
Ramachandran outliers	187476	1029 (3.98-3.66)
Sidechain outliers	187428	1024 (3.98-3.66)
RSRZ outliers	180081	1042 (3.98-3.66)

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 of the lower 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 $\leq 5\%$. 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	136	62% 9% . 28%
1	E	136	60% 12% . 28%
1	K	136	61% 10% . 28%
1	O	136	62% 10% . 27%
2	B	103	62% 15% 23%

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Mol	Chain	Length	Quality of chain
2	F	103	
2	L	103	
2	P	103	
3	C	130	
3	G	130	
3	M	130	
3	Q	130	
4	D	126	
4	H	126	
4	N	126	
4	R	126	
5	I	355	
6	J	355	

2 Entry composition

There are 8 unique types of molecules in this entry. The entry contains 26496 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	98	Total	C	N	O	S	0	0	0
			807	508	156	139	4			
1	K	98	Total	C	N	O	S	0	0	0
			807	508	156	139	4			
1	O	99	Total	C	N	O	S	0	0	0
			816	514	158	140	4			

- Molecule 2 is a protein called Histone H4.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	B	79	Total	C	N	O	S	0	0	0
			627	395	121	110	1			
2	F	79	Total	C	N	O	S	0	0	0
			627	395	121	110	1			
2	L	79	Total	C	N	O	S	0	0	0
			627	395	121	110	1			
2	P	79	Total	C	N	O	S	0	0	0
			627	395	121	110	1			

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

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
3	C	103	Total	C	N	O	0	0	0
			796	502	155	139			
3	G	103	Total	C	N	O	0	0	0
			796	502	155	139			
3	M	103	Total	C	N	O	0	0	0
			796	502	155	139			
3	Q	106	Total	C	N	O	0	0	0
			819	517	160	142			

- 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
			746	468	136	140	2			
4	H	94	Total	C	N	O	S	0	0	0
			735	462	132	139	2			
4	N	95	Total	C	N	O	S	0	0	0
			746	468	136	140	2			
4	R	96	Total	C	N	O	S	0	0	0
			755	474	138	141	2			

- Molecule 5 is a DNA chain called DNA (355-MER).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
5	I	355	Total	C	N	O	P	0	0	0
			7271	3448	1376	2092	355			

- Molecule 6 is a DNA chain called DNA (355-MER).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
6	J	355	Total	C	N	O	P	0	0	0
			7286	3466	1295	2170	355			

- Molecule 7 is CALCIUM ION (CCD ID: CA) (formula: Ca).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	E	1	Total	Ca	0	0
			1	1		
7	G	1	Total	Ca	0	0
			1	1		
7	I	1	Total	Ca	0	0
			1	1		
7	J	1	Total	Ca	0	0
			1	1		

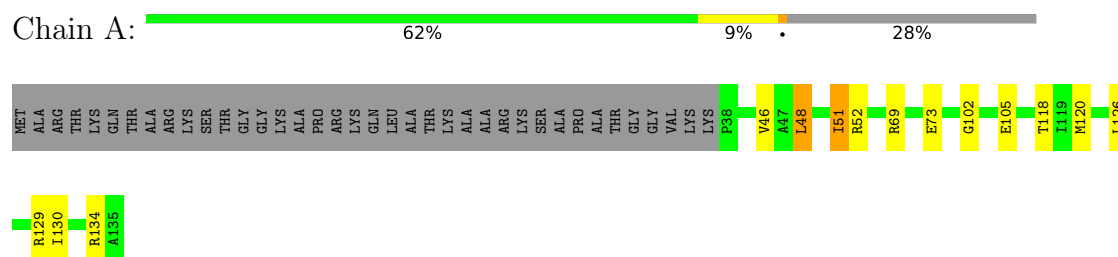
- Molecule 8 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
8	C	1	Total	O	0	0
			1	1		

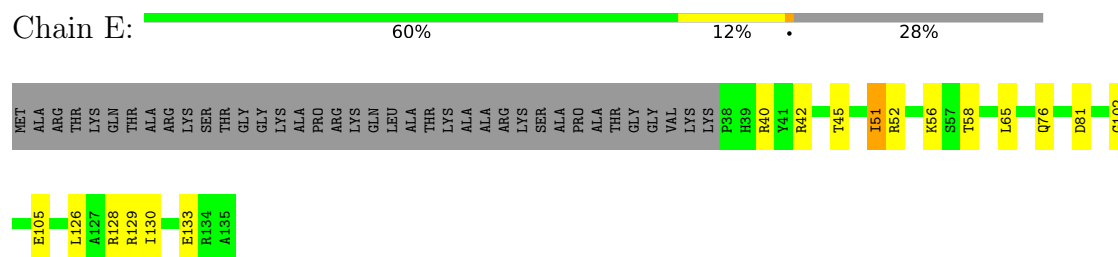
3 Residue-property plots [i](#)

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 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 ($RSRZ > 2$). 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.

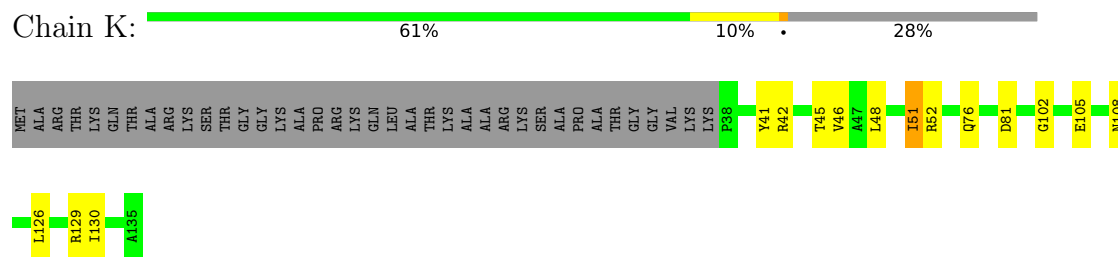
• Molecule 1: Histone H3.1



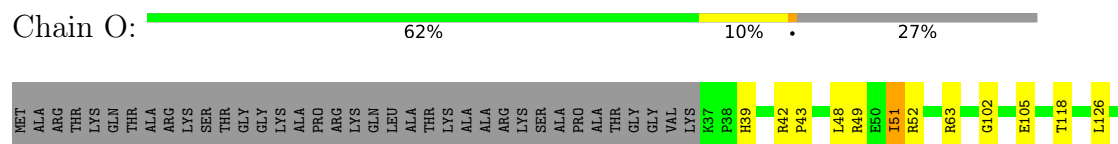
• Molecule 1: Histone H3.1



• Molecule 1: Histone H3.1



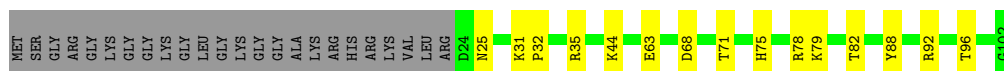
• Molecule 1: Histone H3.1





- Molecule 2: Histone H4

Chain B: 62% 15% 23%



- Molecule 2: Histone H4

Chain F: 64% 13% 23%



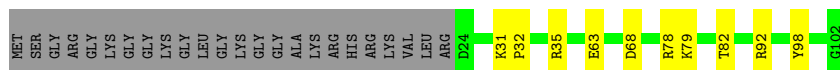
- Molecule 2: Histone H4

Chain L: 66% 11% 23%



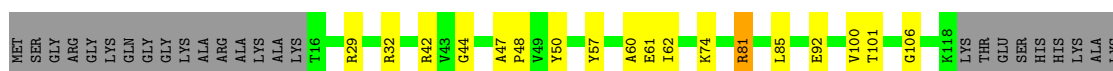
- Molecule 2: Histone H4

Chain P: 67% 10% 23%



- Molecule 3: Histone H2A type 1-B/E

Chain C: 65% 13% 21%



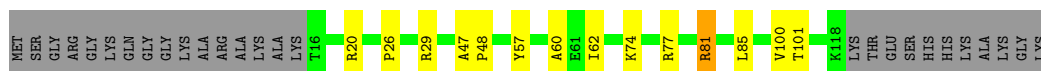
- Molecule 3: Histone H2A type 1-B/E

Chain G: 68% 9% 21%



- Molecule 3: Histone H2A type 1-B/E

Chain M:  68% 10% 21%



- Molecule 3: Histone H2A type 1-B/E

Chain Q:  67% 13% 18%



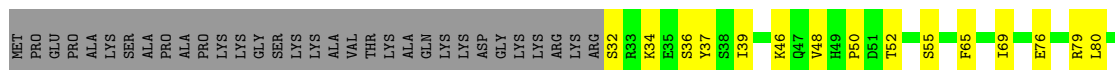
- Molecule 4: Histone H2B type 1-J

Chain D:  60% 14% 25%



- Molecule 4: Histone H2B type 1-J

Chain H:  55% 20% 25%



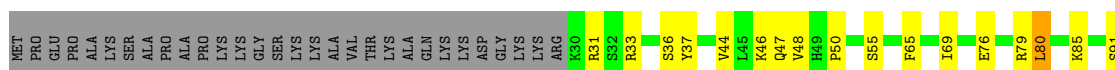
- Molecule 4: Histone H2B type 1-J

Chain N:  59% 17% 25%



- Molecule 4: Histone H2B type 1-J

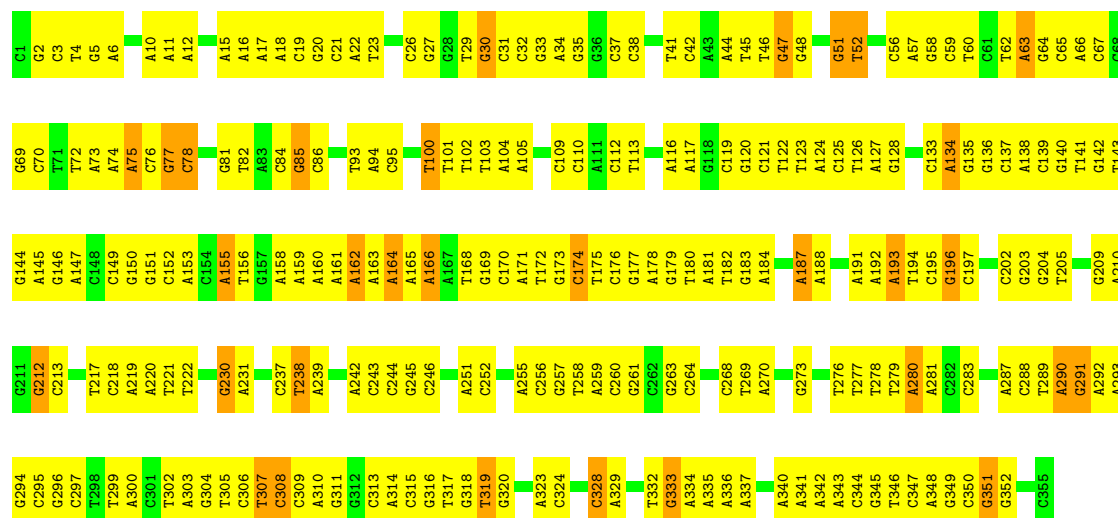
Chain R:  60% 16% 24%





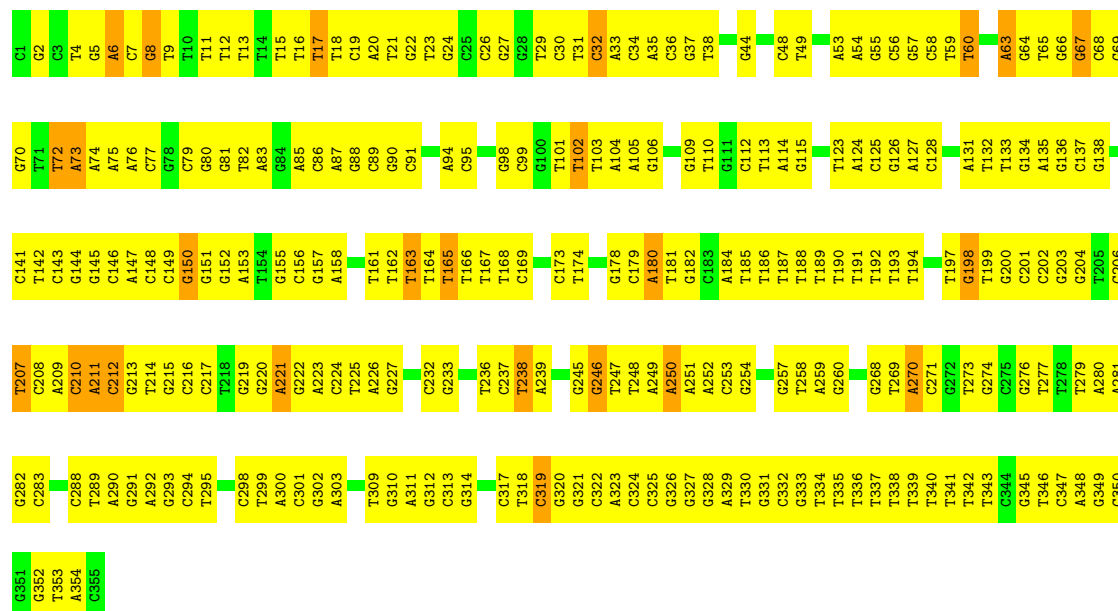
• Molecule 5: DNA (355-MER)

Chain I: 31% 60% 9%



• Molecule 6: DNA (355-MER)

Chain J: 26% 66% 7%



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	85.04Å 218.59Å 115.93Å 90.00° 90.22° 90.00°	Depositor
Resolution (Å)	48.03 – 3.81 48.03 – 3.81	Depositor EDS
% Data completeness (in resolution range)	99.8 (48.03-3.81) 99.8 (48.03-3.81)	Depositor EDS
R_{merge}	0.96	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	1.23 (at 3.77Å)	Xtriage
Refinement program	REFMAC 5.8.0258	Depositor
R, R_{free}	0.208 , 0.286 0.209 , 0.282	Depositor DCC
R_{free} test set	861 reflections (2.08%)	wwPDB-VP
Wilson B-factor (Å ²)	161.7	Xtriage
Anisotropy	0.066	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.29 , 129.8	EDS
L-test for twinning ²	$\langle L \rangle = 0.42$, $\langle L^2 \rangle = 0.24$	Xtriage
Estimated twinning fraction	0.118 for h,-k,-l	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	26496	wwPDB-VP
Average B, all atoms (Å ²)	202.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.74% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical values of $\langle |L| \rangle$, $\langle L^2 \rangle$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 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:
CA

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	0.99	0/819	1.54	0/1097
1	E	1.01	0/819	1.55	0/1097
1	K	1.00	0/819	1.52	0/1097
1	O	1.01	0/828	1.53	0/1109
2	B	0.99	0/634	1.59	0/848
2	F	1.01	0/634	1.59	0/848
2	L	0.99	0/634	1.60	0/848
2	P	1.00	0/634	1.60	0/848
3	C	1.01	0/806	1.55	0/1089
3	G	1.01	0/806	1.54	0/1089
3	M	1.01	0/806	1.55	0/1089
3	Q	1.02	0/829	1.56	0/1118
4	D	1.04	0/757	1.64	0/1015
4	H	1.04	0/746	1.61	0/1001
4	N	1.04	0/757	1.61	0/1015
4	R	1.03	1/766 (0.1%)	1.64	0/1026
5	I	0.37	0/8168	0.92	42/12594 (0.3%)
6	J	0.37	0/8162	0.93	35/12603 (0.3%)
All	All	0.72	1/28424 (0.0%)	1.22	77/41431 (0.2%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
4	R	31	ARG	N-CA	5.08	1.49	1.46

The worst 5 of 77 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	I	85	DG	C4'-C3'-O3'	8.25	122.37	110.00
6	J	17	DT	C2'-C3'-O3'	-8.17	99.25	111.50

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	I	196	DG	C2'-C3'-O3'	-7.80	99.80	111.50
5	I	259	DA	C2'-C3'-O3'	-7.46	100.31	111.50
5	I	174	DC	C4'-C3'-O3'	7.45	121.17	110.00

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	8	0
1	E	807	0	844	12	0
1	K	807	0	844	14	0
1	O	816	0	856	9	0
2	B	627	0	663	11	0
2	F	627	0	663	11	0
2	L	627	0	663	7	0
2	P	627	0	663	6	0
3	C	796	0	848	17	0
3	G	796	0	848	10	0
3	M	796	0	848	10	0
3	Q	819	0	879	14	0
4	D	746	0	771	16	0
4	H	735	0	758	17	0
4	N	746	0	771	12	0
4	R	755	0	784	13	0
5	I	7271	0	3971	310	0
6	J	7286	0	4010	319	0
7	E	1	0	0	0	0
7	G	1	0	0	0	0
7	I	1	0	0	0	0
7	J	1	0	0	0	0
8	C	1	0	0	0	0
All	All	26496	0	20528	724	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 16.

The worst 5 of 724 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)
5:I:143:DT:H2''	5:I:144:DG:C8	1.79	1.18
6:J:309:DT:H2''	6:J:310:DG:C8	1.89	1.08
6:J:94:DA:H2''	6:J:95:DC:C6	1.89	1.07
6:J:15:DT:H2'	6:J:16:DT:H71	1.38	1.00
5:I:291:DG:H1'	5:I:292:DA:C8	1.97	0.99

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	96/136 (71%)	85 (88%)	10 (10%)	1 (1%)	12	44
1	E	96/136 (71%)	85 (88%)	10 (10%)	1 (1%)	12	44
1	K	96/136 (71%)	84 (88%)	11 (12%)	1 (1%)	12	44
1	O	97/136 (71%)	86 (89%)	10 (10%)	1 (1%)	12	44
2	B	77/103 (75%)	65 (84%)	11 (14%)	1 (1%)	9	39
2	F	77/103 (75%)	65 (84%)	11 (14%)	1 (1%)	9	39
2	L	77/103 (75%)	65 (84%)	11 (14%)	1 (1%)	9	39
2	P	77/103 (75%)	65 (84%)	11 (14%)	1 (1%)	9	39
3	C	101/130 (78%)	84 (83%)	17 (17%)	0	100	100
3	G	101/130 (78%)	85 (84%)	16 (16%)	0	100	100
3	M	101/130 (78%)	85 (84%)	16 (16%)	0	100	100
3	Q	104/130 (80%)	87 (84%)	17 (16%)	0	100	100
4	D	93/126 (74%)	78 (84%)	13 (14%)	2 (2%)	5	30

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
4	H	92/126 (73%)	78 (85%)	13 (14%)	1 (1%)	11	42
4	N	93/126 (74%)	79 (85%)	13 (14%)	1 (1%)	11	42
4	R	94/126 (75%)	78 (83%)	14 (15%)	2 (2%)	5	31
All	All	1472/1980 (74%)	1254 (85%)	204 (14%)	14 (1%)	12	44

5 of 14 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
4	R	33	ARG
4	D	33	ARG
4	D	104	GLY
4	H	104	GLY
4	N	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	85/111 (77%)	81 (95%)	4 (5%)	23	48
1	E	85/111 (77%)	84 (99%)	1 (1%)	63	71
1	K	85/111 (77%)	83 (98%)	2 (2%)	43	62
1	O	86/111 (78%)	82 (95%)	4 (5%)	23	48
2	B	64/79 (81%)	63 (98%)	1 (2%)	55	68
2	F	64/79 (81%)	64 (100%)	0	100	100
2	L	64/79 (81%)	63 (98%)	1 (2%)	55	68
2	P	64/79 (81%)	64 (100%)	0	100	100
3	C	82/100 (82%)	78 (95%)	4 (5%)	22	47
3	G	82/100 (82%)	78 (95%)	4 (5%)	22	47
3	M	82/100 (82%)	79 (96%)	3 (4%)	30	53
3	Q	84/100 (84%)	78 (93%)	6 (7%)	13	39
4	D	81/105 (77%)	76 (94%)	5 (6%)	16	42

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
4	H	80/105 (76%)	75 (94%)	5 (6%)	16	42
4	N	81/105 (77%)	74 (91%)	7 (9%)	10	33
4	R	82/105 (78%)	77 (94%)	5 (6%)	17	43
All	All	1251/1580 (79%)	1199 (96%)	52 (4%)	26	50

5 of 52 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
3	M	81	ARG
4	N	91	SER
4	R	85	LYS
3	M	101	THR
4	N	52	THR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 22 such sidechains are listed below:

Mol	Chain	Res	Type
4	N	67	ASN
1	O	108	ASN
1	O	76	GLN
2	P	64	ASN
1	E	108	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

Of 4 ligands modelled in this entry, 4 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 [i](#)

6.1 Protein, DNA and RNA chains [i](#)

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, 95th 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 ²)	Q<0.9
1	A	98/136 (72%)	-0.78	0 100 100	85, 148, 195, 218	0
1	E	98/136 (72%)	-0.72	0 100 100	98, 148, 214, 245	0
1	K	98/136 (72%)	-0.77	0 100 100	94, 131, 194, 218	0
1	O	99/136 (72%)	-0.80	0 100 100	104, 142, 213, 251	0
2	B	79/103 (76%)	-0.82	0 100 100	97, 147, 213, 224	0
2	F	79/103 (76%)	-0.70	0 100 100	102, 154, 205, 266	0
2	L	79/103 (76%)	-0.83	0 100 100	96, 132, 179, 234	0
2	P	79/103 (76%)	-0.74	0 100 100	107, 134, 166, 231	0
3	C	103/130 (79%)	-0.75	0 100 100	121, 173, 241, 299	0
3	G	103/130 (79%)	-0.74	0 100 100	109, 177, 238, 269	0
3	M	103/130 (79%)	-0.68	0 100 100	107, 146, 205, 223	0
3	Q	106/130 (81%)	-0.85	0 100 100	102, 150, 231, 296	0
4	D	95/126 (75%)	-0.80	0 100 100	129, 183, 230, 289	0
4	H	94/126 (74%)	-0.77	0 100 100	145, 195, 241, 282	0
4	N	95/126 (75%)	-0.85	0 100 100	109, 152, 233, 280	0
4	R	96/126 (76%)	-0.91	0 100 100	96, 153, 218, 229	0
5	I	355/355 (100%)	-0.73	0 100 100	123, 228, 329, 378	0
6	J	355/355 (100%)	-0.75	0 100 100	140, 229, 326, 396	0
All	All	2214/2690 (82%)	-0.77	0 100 100	85, 174, 295, 396	0

There are no RSRZ outliers to report.

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

There are no non-standard protein/DNA/RNA residues in this entry.

6.3 Carbohydrates [i](#)

There are no oligosaccharides in this entry.

6.4 Ligands [i](#)

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. The B-factors column lists the minimum, median, 95th 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	B-factors($\text{\AA}^2$)	Q<0.9
7	CA	G	201	1/1	0.84	0.09	182,182,182,182	0
7	CA	I	401	1/1	0.95	0.04	135,135,135,135	0
7	CA	J	401	1/1	0.96	0.03	168,168,168,168	0
7	CA	E	201	1/1	0.98	0.05	142,142,142,142	0

6.5 Other polymers [i](#)

There are no such residues in this entry.