



wwPDB X-ray Structure Validation Summary Report ⓘ

Feb 19, 2016 – 09:42 PM GMT

PDB ID : 5B0Y
Title : Crystal structure of the nucleosome containing histone H3 with the crotonylated lysine 122
Authors : Suzuki, Y.; Horikoshi, N.; Kurumizaka, H.
Deposited on : 2015-11-13
Resolution : 2.56 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
<http://wwpdb.org/validation/2016/XrayValidationReportHelp>
with specific help available everywhere you see the ⓘ symbol.

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

MolProbity : 4.02b-467
Mogul : 1.7.1 (RC1), CSD as537be (2016)
Xtriage (Phenix) : 1.9-1692
EDS : rb-20026982
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) : rb-20026982

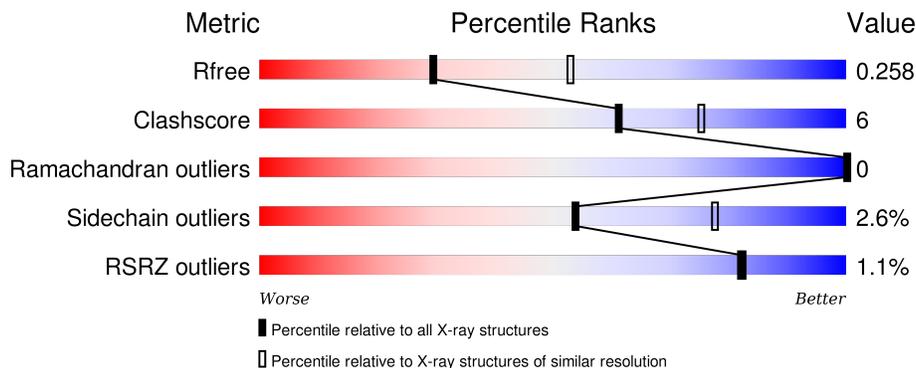
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.56 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	3324 (2.60-2.52)
Clashscore	102246	3729 (2.60-2.52)
Ramachandran outliers	100387	3673 (2.60-2.52)
Sidechain outliers	100360	3673 (2.60-2.52)
RSRZ outliers	91569	3333 (2.60-2.52)

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 ≥ 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	136	
1	E	136	
2	B	106	
2	F	106	
3	C	133	

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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	301	-	-	-	X

2 Entry composition [i](#)

There are 8 unique types of molecules in this entry. The entry contains 11993 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 H3.2.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	96	799	504	154	138	3	0	0	0
1	E	99	821	518	158	142	3	0	0	0

- Molecule 2 is a protein called Histone H4.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	B	78	619	391	120	107	1	0	0	0
2	F	84	673	424	133	115	1	0	0	0

There are 6 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
F	-3	GLY	-	expression tag	UNP P62805
F	-2	SER	-	expression tag	UNP P62805
F	-1	HIS	-	expression tag	UNP P62805

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

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
			Total	C	N	O			
3	C	105	810	511	158	141	0	0	0
3	G	104	805	508	157	140	0	0	0

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	93	Total	C	N	O	S	0	0	0
			725	456	130	137	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 DNA (146-MER).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
5	I	146	Total	C	N	O	P	0	0	0
			2990	1431	540	874	145			
5	J	146	Total	C	N	O	P	0	0	0
			2990	1431	540	874	145			

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

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

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

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
7	J	4	Total Mn 4 4	0	0
7	I	3	Total Mn 3 3	0	0
7	E	1	Total Mn 1 1	0	0

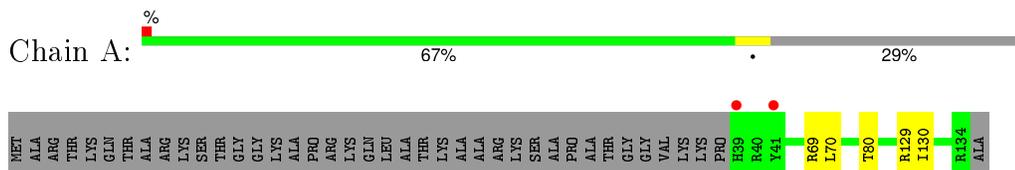
- Molecule 8 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
8	A	4	Total O 4 4	0	0
8	C	4	Total O 4 4	0	0
8	D	2	Total O 2 2	0	0
8	E	5	Total O 5 5	0	0
8	F	6	Total O 6 6	0	0
8	G	2	Total O 2 2	0	0
8	I	6	Total O 6 6	0	0
8	J	3	Total O 3 3	0	0

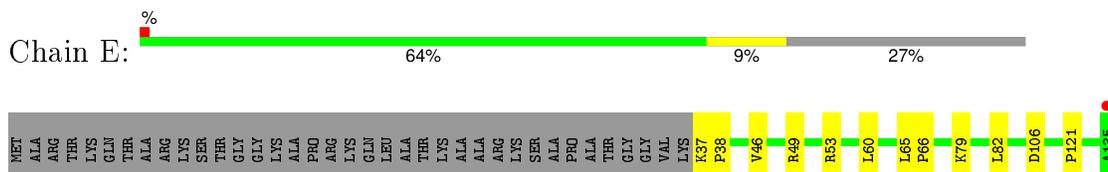
3 Residue-property plots [i](#)

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 ($RSRZ > 2$). 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.

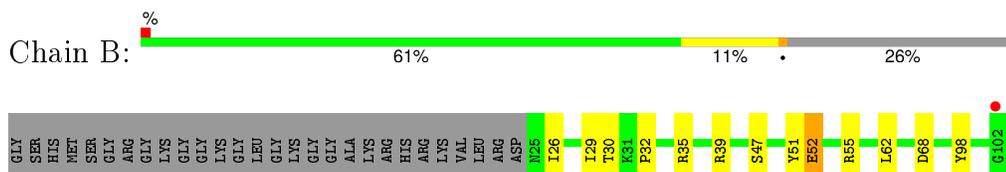
- Molecule 1: Histone H3.2



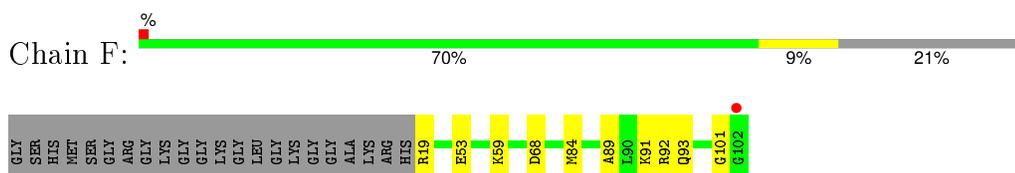
- Molecule 1: Histone H3.2



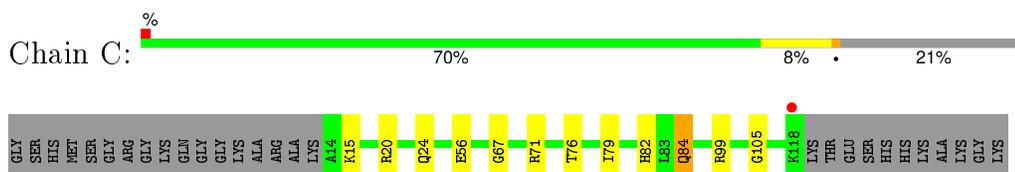
- Molecule 2: Histone H4



- Molecule 2: Histone H4



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



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





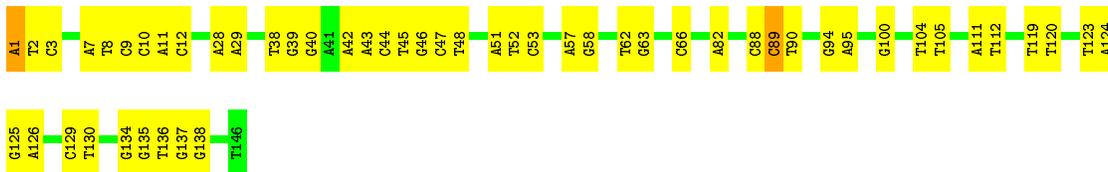
• Molecule 4: Histone H2B type 1-J



• Molecule 4: Histone H2B type 1-J



• Molecule 5: DNA (146-MER)



• Molecule 5: DNA (146-MER)



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	99.64Å 108.77Å 171.14Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	49.82 – 2.56 49.82 – 2.56	Depositor EDS
% Data completeness (in resolution range)	98.2 (49.82-2.56) 97.9 (49.82-2.56)	Depositor EDS
R_{merge}	0.10	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.42 (at 2.54Å)	Xtrriage
Refinement program	PHENIX	Depositor
R, R_{free}	0.210 , 0.249 0.222 , 0.258	Depositor DCC
R_{free} test set	3021 reflections (5.34%)	DCC
Wilson B-factor (Å ²)	44.9	Xtrriage
Anisotropy	0.179	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.28 , 36.9	EDS
Estimated twinning fraction	No twinning to report.	Xtrriage
L-test for twinning ²	$\langle L \rangle = 0.45$, $\langle L^2 \rangle = 0.28$	Xtrriage
Outliers	0 of 59772 reflections	Xtrriage
F_o, F_c correlation	0.93	EDS
Total number of atoms	11993	wwPDB-VP
Average B, all atoms (Å ²)	57.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.98% 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, 0.375 respectively for untwinned datasets, and 0.333, 0.2 for perfectly twinned datasets.

5 Model quality [i](#)

5.1 Standard geometry [i](#)

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

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	0.49	0/795	0.59	0/1065
1	E	0.55	0/818	0.65	0/1095
2	B	0.47	0/626	0.67	0/837
2	F	0.54	0/680	0.73	0/908
3	C	0.47	0/820	0.63	0/1107
3	G	0.42	0/815	0.63	0/1100
4	D	0.48	0/736	0.59	1/990 (0.1%)
4	H	0.49	0/730	0.57	0/982
5	I	0.83	3/3354 (0.1%)	1.01	2/5175 (0.0%)
5	J	0.84	0/3354	1.02	0/5175
All	All	0.70	3/12728 (0.0%)	0.87	3/18434 (0.0%)

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	I	89	DC	C3'-O3'	-5.82	1.36	1.44
5	I	66	DC	C3'-O3'	-5.76	1.36	1.44
5	I	1	DA	C3'-O3'	5.16	1.50	1.44

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	D	101	LEU	CB-CG-CD2	-5.64	101.41	111.00
5	I	1	DA	P-O3'-C3'	5.51	126.31	119.70
5	I	1	DA	OP2-P-O3'	5.19	116.61	105.20

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	A	799	0	834	3	0
1	E	821	0	859	10	0
2	B	619	0	659	9	0
2	F	673	0	722	8	0
3	C	810	0	866	6	0
3	G	805	0	861	11	0
4	D	725	0	745	11	0
4	H	719	0	740	9	0
5	I	2990	0	1652	44	0
5	J	2990	0	1652	28	0
6	C	1	0	0	0	0
6	G	1	0	0	0	0
7	E	1	0	0	0	0
7	I	3	0	0	0	0
7	J	4	0	0	0	0
8	A	4	0	0	0	0
8	C	4	0	0	0	0
8	D	2	0	0	0	0
8	E	5	0	0	0	0
8	F	6	0	0	1	0
8	G	2	0	0	0	0
8	I	6	0	0	1	0
8	J	3	0	0	0	0
All	All	11993	0	9590	114	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 6.

The worst 5 of 114 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:46:DG:H2'	5:I:47:DC:H5''	1.62	0.81
5:J:282:DT:H2''	5:J:283:DG:H5''	1.61	0.80
3:C:71:ARG:NH2	4:D:51:ASP:OD2	2.16	0.78
5:I:134:DG:H2'	5:I:135:DG:C8	2.18	0.78

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
4:D:86:ARG:HH12	5:I:40:DG:P	2.07	0.76

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	93/136 (68%)	92 (99%)	1 (1%)	0	100	100
1	E	96/136 (71%)	96 (100%)	0	0	100	100
2	B	76/106 (72%)	76 (100%)	0	0	100	100
2	F	82/106 (77%)	81 (99%)	1 (1%)	0	100	100
3	C	103/133 (77%)	100 (97%)	3 (3%)	0	100	100
3	G	102/133 (77%)	97 (95%)	5 (5%)	0	100	100
4	D	91/129 (70%)	88 (97%)	3 (3%)	0	100	100
4	H	90/129 (70%)	89 (99%)	1 (1%)	0	100	100
All	All	733/1008 (73%)	719 (98%)	14 (2%)	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 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	83/110 (76%)	81 (98%)	2 (2%)	57	80
1	E	85/110 (77%)	84 (99%)	1 (1%)	78	91
2	B	63/81 (78%)	60 (95%)	3 (5%)	31	54
2	F	69/81 (85%)	68 (99%)	1 (1%)	74	89
3	C	83/102 (81%)	80 (96%)	3 (4%)	42	67
3	G	83/102 (81%)	82 (99%)	1 (1%)	78	91
4	D	79/107 (74%)	77 (98%)	2 (2%)	55	79
4	H	78/107 (73%)	75 (96%)	3 (4%)	40	65
All	All	623/800 (78%)	607 (97%)	16 (3%)	54	77

5 of 16 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
3	C	99	ARG
4	D	32	SER
3	G	36	LYS
3	C	84	GLN
4	H	34	LYS

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (1) such sidechains are listed below:

Mol	Chain	Res	Type
3	G	73	ASN

5.3.3 RNA [i](#)

There are no RNA molecules in this entry.

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

2 non-standard protein/DNA/RNA residues are modelled in this entry.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the chemical component dictionary. The Link column lists molecule types, if any, to which the group is linked. 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 $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z > 2	Counts	RMSZ	# Z > 2
1	KCR	A	122	1	11,13,14	2.67	3 (27%)	12,14,16	2.07	6 (50%)
1	KCR	E	122	1	11,13,14	3.57	2 (18%)	12,14,16	1.69	4 (33%)

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the chemical component dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
1	KCR	A	122	1	-	0/11/13/15	0/0/0/0
1	KCR	E	122	1	-	0/11/13/15	0/0/0/0

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	122	KCR	OH-CH	-2.52	1.19	1.24
1	A	122	KCR	CX-CH	3.10	1.54	1.48
1	E	122	KCR	CX-CH	3.83	1.55	1.48
1	A	122	KCR	CH-NZ	7.65	1.44	1.34
1	E	122	KCR	CH-NZ	10.95	1.49	1.34

The worst 5 of 10 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	122	KCR	OH-CH-NZ	-3.74	117.85	122.57
1	A	122	KCR	CD-CG-CB	-2.60	104.44	113.67
1	E	122	KCR	CH3-CY-CX	-2.50	119.92	125.42
1	A	122	KCR	CE-NZ-CH	-2.36	119.07	122.39
1	A	122	KCR	CH3-CY-CX	-2.36	120.22	125.42

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

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 [i](#)

There are no such residues in this entry.

5.8 Polymer linkage issues [i](#)

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	95/136 (69%)	-0.17	2 (2%) 67 65	28, 40, 59, 70	0
1	E	98/136 (72%)	-0.26	1 (1%) 84 84	21, 31, 54, 73	0
2	B	78/106 (73%)	-0.15	1 (1%) 79 78	28, 37, 50, 60	0
2	F	84/106 (79%)	-0.05	1 (1%) 81 80	23, 29, 43, 64	0
3	C	105/133 (78%)	-0.22	1 (0%) 84 84	24, 34, 49, 64	0
3	G	104/133 (78%)	-0.11	2 (1%) 70 68	28, 39, 64, 72	0
4	D	93/129 (72%)	-0.05	1 (1%) 82 82	25, 34, 52, 74	0
4	H	92/129 (71%)	0.06	2 (2%) 65 64	27, 38, 56, 76	0
5	I	146/146 (100%)	-0.45	0 100 100	39, 75, 108, 122	0
5	J	146/146 (100%)	-0.37	0 100 100	43, 73, 110, 117	0
All	All	1041/1300 (80%)	-0.20	11 (1%) 82 82	21, 40, 95, 122	0

The worst 5 of 11 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	F	102	GLY	6.3
2	B	102	GLY	4.1
3	G	74	LYS	2.9
4	D	32	SER	2.6
1	E	135	ALA	2.5

6.2 Non-standard residues in protein, DNA, RNA chains [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. 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, 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	LLDF	B-factors(Å ²)	Q<0.9
1	KCR	A	122	14/15	0.89	0.23	-	31,46,70,73	0
1	KCR	E	122	14/15	0.81	0.32	-	32,45,65,66	0

6.3 Carbohydrates [i](#)

There are no carbohydrates 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. 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, 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	LLDF	B-factors(Å ²)	Q<0.9
7	MN	E	301	1/1	0.97	0.26	5.02	41,41,41,41	0
6	CL	C	301	1/1	0.98	0.14	0.80	53,53,53,53	0
6	CL	G	201	1/1	0.96	0.11	-0.75	52,52,52,52	0
7	MN	J	303	1/1	0.95	0.23	-	84,84,84,84	0
7	MN	I	301	1/1	0.82	0.15	-	92,92,92,92	0
7	MN	J	302	1/1	0.93	0.23	-	93,93,93,93	0
7	MN	J	304	1/1	0.98	0.13	-	72,72,72,72	0
7	MN	I	302	1/1	0.67	0.11	-	108,108,108,108	0
7	MN	I	303	1/1	0.95	0.27	-	75,75,75,75	0
7	MN	J	301	1/1	0.95	0.20	-	71,71,71,71	0

6.5 Other polymers [i](#)

There are no such residues in this entry.