wwPDB X-ray Structure Validation Summary Report (i)

Oct 22, 2023 – 08:24 PM EDT

PDB ID	:	3AZI
Title	:	Crystal Structure of Human Nucleosome Core Particle Containing H4K31Q mutation
Authors	:	Iwasaki, W.; Tachiwana, H.; Kawaguchi, K.; Shibata, T.; Kagawa, W.; Kurumizaka, H.
Deposited on	:	2011-05-25
Resolution	:	2.70 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 (i) 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 (1)) were used in the production of this report:

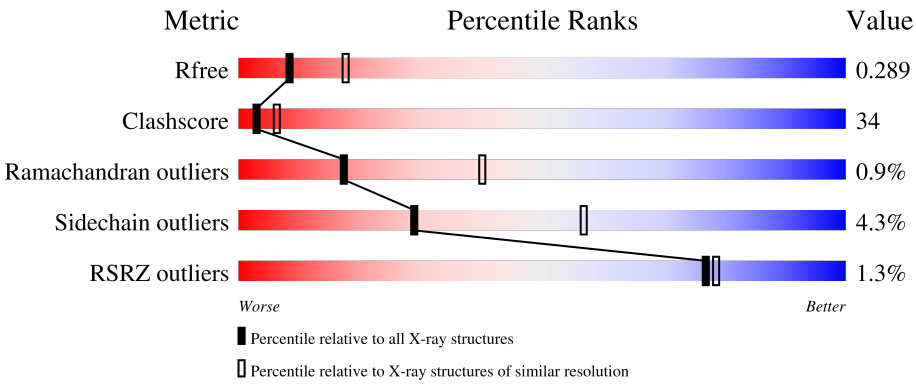
MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.13
EDS	:	2.36
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.36

1 Overall quality at a glance (i)

The following experimental techniques were used to determine the structure:
X-RAY DIFFRACTION

The reported resolution of this entry is 2.70 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}	130704	2808 (2.70-2.70)
Clashscore	141614	3122 (2.70-2.70)
Ramachandran outliers	138981	3069 (2.70-2.70)
Sidechain outliers	138945	3069 (2.70-2.70)
RSRZ outliers	127900	2737 (2.70-2.70)

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 <=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	% 44% 24% • 29%
1	E	139	% 45% 25% • 29%
2	B	106	42% 29% • 26%
2	F	106	57% 22% • 21%
3	C	133	2% 54% 23% • 19%

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Mol	Chain	Length	Quality of chain
3	G	133	% 49% 27% • 22%
4	D	129	3% 47% 24% • 26%
4	H	129	% 46% 25% • 28%
5	I	146	% 10% 90% •
5	J	146	% • 97% •

2 Entry composition (i)

There are 8 unique types of molecules in this entry. The entry contains 12053 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
			Total	C	N	O	S			
1	A	98	807	508	156	139	4	0	0	0
1	E	99	816	514	158	140	4	0	0	0

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
			Total	C	N	O	S			
2	B	78	619	390	120	108	1	0	0	0
2	F	84	673	423	133	116	1	0	0	0

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	31	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	31	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
			Total	C	N	O			
3	C	108	835	526	165	144	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
			Total	C	N	O	S			
4	D	95	745	468	136	139	2	0	0	0
4	H	93	725	456	130	137	2	0	0	0

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
			Total	C	N	O	P			
5	I	145	2970	1421	538	867	144	0	0	0
5	J	145	2969	1421	535	869	144	0	0	0

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

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

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

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	Mn		
7	E	1	1	1	0	0
7	I	5	5	5	0	0
7	J	7	7	7	0	0

- Molecule 8 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
8	A	6	6	6	0	0
8	B	6	6	6	0	0
8	C	11	11	11	0	0
8	D	3	3	3	0	0
8	E	18	18	18	0	0
8	F	12	12	12	0	0

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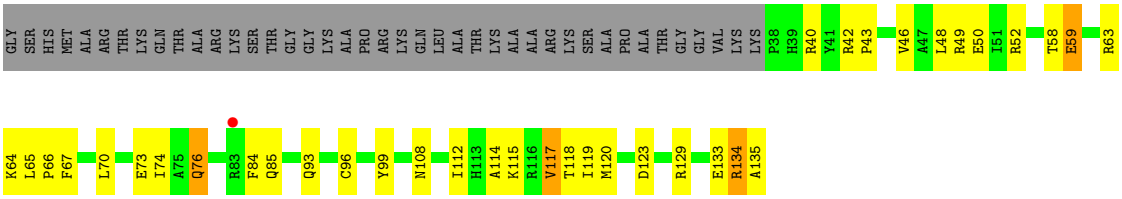
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	O		
8	G	7	7	7	0	0
			Total	O		
8	H	2	2	2	0	0
			Total	O		
8	I	3	3	3	0	0
			Total	O		
8	J	4	4	4	0	0

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.

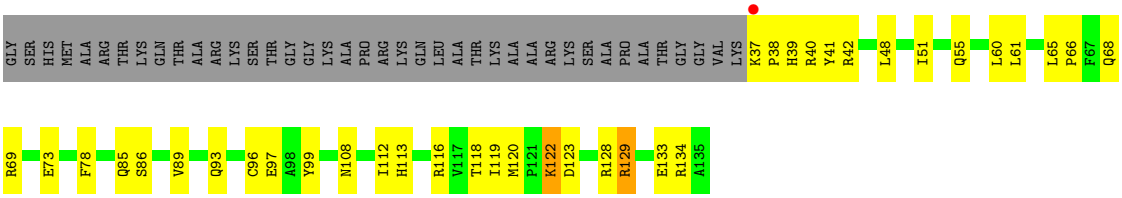
• Molecule 1: Histone H3.1

Chain A:



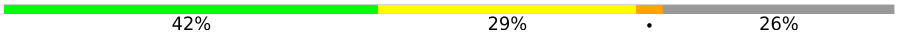
• Molecule 1: Histone H3.1

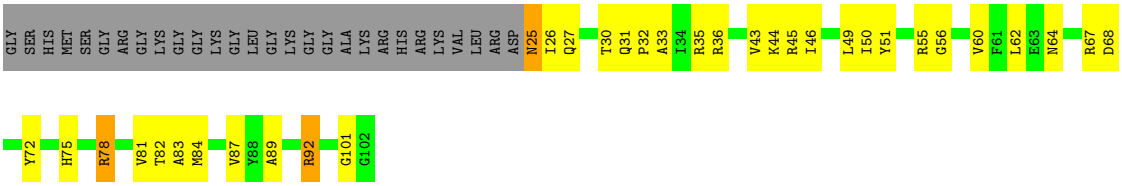
Chain E:



• Molecule 2: Histone H4

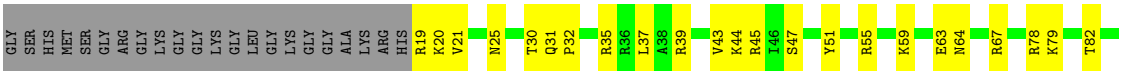
Chain B:





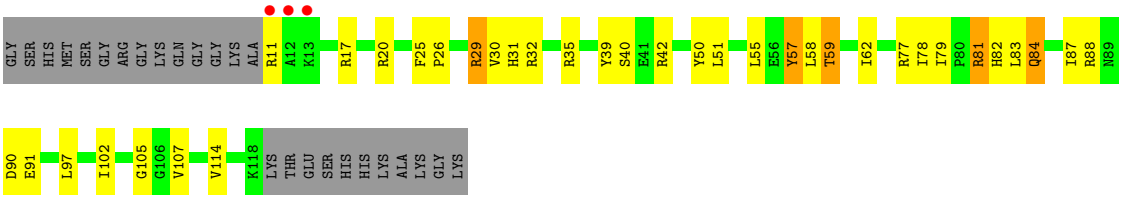
• Molecule 2: Histone H4

Chain F:



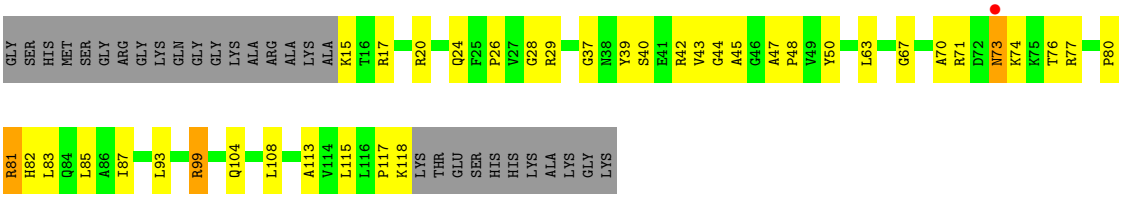
• Molecule 3: Histone H2A type 1-B/E

Chain C:



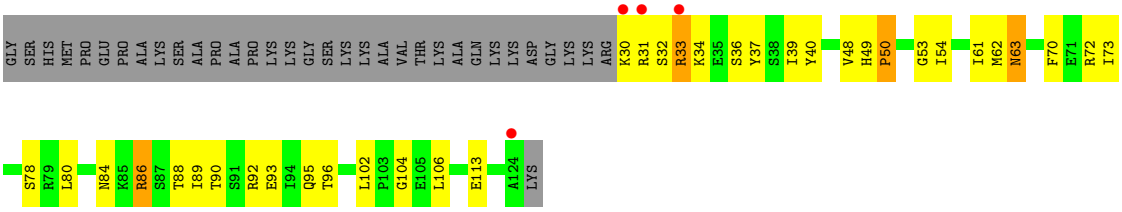
• Molecule 3: Histone H2A type 1-B/E

Chain G:



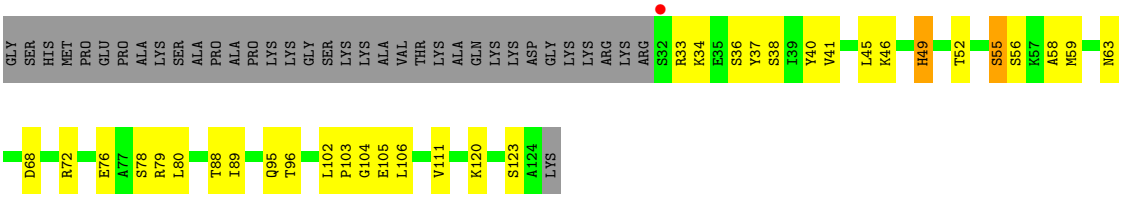
• Molecule 4: Histone H2B type 1-J

Chain D:



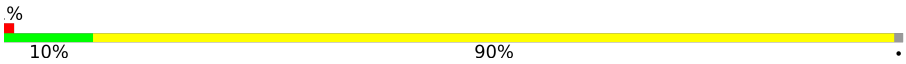
• Molecule 4: Histone H2B type 1-J

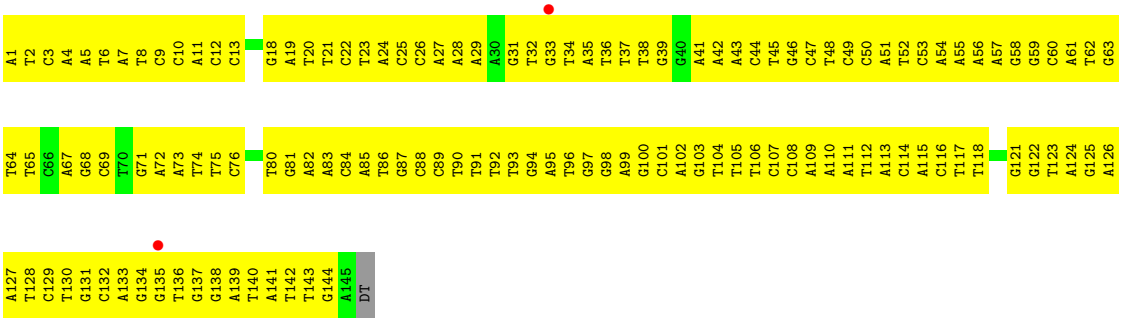
Chain H:



• Molecule 5: 146-MER DNA

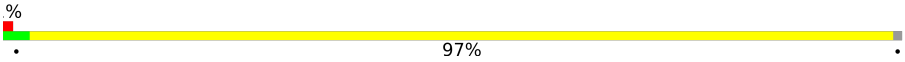
Chain I:

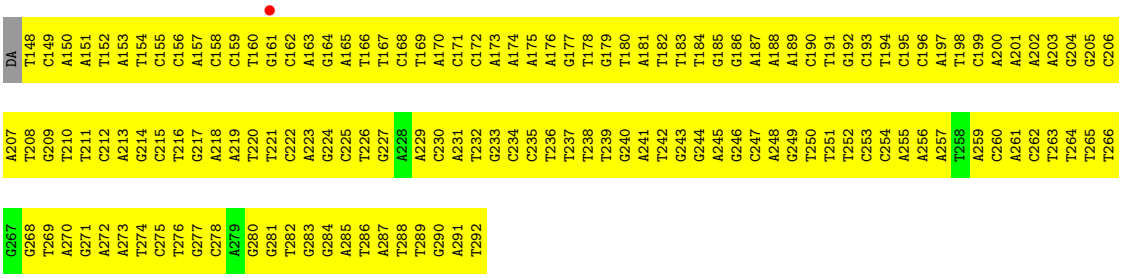




- Molecule 5: 146-MER DNA

Chain J:





4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	106.36Å 109.45Å 176.01Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	38.14 – 2.70 38.14 – 2.70	Depositor EDS
% Data completeness (in resolution range)	99.5 (38.14-2.70) 99.5 (38.14-2.70)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.08	Depositor
$< I/\sigma(I) >$ [1]	3.00 (at 2.69Å)	Xtriage
Refinement program	CNS 1.2	Depositor
R, R_{free}	0.230 , 0.289 0.230 , 0.289	Depositor DCC
R_{free} test set	2874 reflections (5.07%)	wwPDB-VP
Wilson B-factor (Å^2)	63.8	Xtriage
Anisotropy	0.605	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.29 , 78.1	EDS
L-test for twinning[2]	$< \|L\| > = 0.45$, $< L^2 > = 0.28$	Xtriage
Estimated twinning fraction	0.033 for k,h,-l	Xtriage
F_o,F_c correlation	0.94	EDS
Total number of atoms	12053	wwPDB-VP
Average B, all atoms (Å^2)	94.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.62% of the height of the origin peak. No significant pseudotranslation is detected.*

[1]Intensities estimated from amplitudes.

[2]Theoretical values of $< |L| >$, $< L^2 >$ for acentric reflections are 0.5, 0.333 respectively for untwinned datasets, and 0.375, 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: 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	0.43	0/819	0.63	0/1097
1	E	0.53	0/828	0.70	0/1109
2	B	0.41	0/626	0.67	0/838
2	F	0.51	0/680	0.74	0/909
3	C	0.44	0/845	0.65	0/1139
3	G	0.38	0/815	0.60	0/1100
4	D	0.47	0/756	0.71	1/1015 (0.1%)
4	H	0.44	0/736	0.64	0/990
5	I	0.39	0/3332	0.77	0/5141
5	J	0.38	0/3330	0.78	0/5138
All	All	0.42	0/12767	0.73	1/18476 (0.0%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand.A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
3	C	0	1

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
4	D	72	ARG	NE-CZ-NH2	5.09	122.84	120.30

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
3	C	57	TYR	Sidechain

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	807	0	844	54	0
1	E	816	0	856	44	0
2	B	619	0	654	35	0
2	F	673	0	717	24	0
3	C	835	0	897	53	0
3	G	805	0	861	54	0
4	D	745	0	771	47	0
4	H	725	0	745	39	0
5	I	2970	0	1640	249	0
5	J	2969	0	1641	268	0
6	A	1	0	0	0	0
6	C	1	0	0	0	0
6	E	1	0	0	1	0
6	G	1	0	0	0	0
7	E	1	0	0	0	0
7	I	5	0	0	0	0
7	J	7	0	0	0	0
8	A	6	0	0	0	0
8	B	6	0	0	1	0
8	C	11	0	0	2	0
8	D	3	0	0	0	0
8	E	18	0	0	1	0
8	F	12	0	0	0	0
8	G	7	0	0	1	0
8	H	2	0	0	0	0
8	I	3	0	0	1	0
8	J	4	0	0	0	0
All	All	12053	0	9626	744	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 34.

The worst 5 of 744 close contacts within the same asymmetric unit are listed below, sorted by their clash magnitude.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:E:134:ARG:HH11	1:E:134:ARG:HB3	1.04	1.16
5:I:55:DA:H2"	5:I:56:DA:H5'	1.27	1.14
5:J:185:DG:H2"	5:J:186:DG:H5"	1.24	1.14
5:J:188:DA:H2"	5:J:189:DA:H5'	1.23	1.13
5:I:136:DT:H2"	5:I:137:DG:H5"	1.14	1.09

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%)	87 (91%)	8 (8%)	1 (1%)	15	37
1	E	97/139 (70%)	89 (92%)	8 (8%)	0	100	100
2	B	76/106 (72%)	71 (93%)	5 (7%)	0	100	100
2	F	82/106 (77%)	79 (96%)	3 (4%)	0	100	100
3	C	106/133 (80%)	103 (97%)	3 (3%)	0	100	100
3	G	102/133 (77%)	89 (87%)	12 (12%)	1 (1%)	15	37
4	D	93/129 (72%)	85 (91%)	6 (6%)	2 (2%)	6	17
4	H	91/129 (70%)	81 (89%)	7 (8%)	3 (3%)	4	8
All	All	743/1014 (73%)	684 (92%)	52 (7%)	7 (1%)	17	40

5 of 7 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
4	D	104	GLY
3	G	113	ALA
4	H	104	GLY
4	H	55	SER
4	D	50	PRO

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	85/113 (75%)	81 (95%)	4 (5%)	26	54
1	E	86/113 (76%)	84 (98%)	2 (2%)	50	78
2	B	63/81 (78%)	60 (95%)	3 (5%)	25	53
2	F	69/81 (85%)	67 (97%)	2 (3%)	42	71
3	C	85/102 (83%)	81 (95%)	4 (5%)	26	54
3	G	83/102 (81%)	80 (96%)	3 (4%)	35	64
4	D	81/107 (76%)	74 (91%)	7 (9%)	10	24
4	H	79/107 (74%)	77 (98%)	2 (2%)	47	76
All	All	631/806 (78%)	604 (96%)	27 (4%)	29	57

5 of 27 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
4	D	50	PRO
4	D	93	GLU
3	G	99	ARG
4	D	86	ARG
1	E	122	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 23 such sidechains are listed below:

Mol	Chain	Res	Type
2	F	31	GLN
2	F	93	GLN
2	F	75	HIS
3	G	24	GLN
2	B	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 monosaccharides in this entry.

5.6 Ligand geometry (i)

Of 17 ligands modelled in this entry, 17 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	98/139 (70%)	0.12	1 (1%)	82	83	36, 72, 99, 126	0
1	E	99/139 (71%)	0.02	1 (1%)	82	83	35, 53, 82, 118	0
2	B	78/106 (73%)	0.08	0	100	100	48, 67, 95, 110	0
2	F	84/106 (79%)	0.01	0	100	100	30, 48, 65, 95	0
3	C	108/133 (81%)	0.12	3 (2%)	53	54	33, 58, 93, 147	0
3	G	104/133 (78%)	0.02	1 (0%)	82	83	47, 66, 102, 119	0
4	D	95/129 (73%)	0.15	4 (4%)	36	35	29, 62, 94, 151	0
4	H	93/129 (72%)	-0.05	1 (1%)	80	82	43, 64, 108, 123	0
5	I	145/146 (99%)	0.00	2 (1%)	75	77	55, 129, 159, 173	0
5	J	145/146 (99%)	-0.04	1 (0%)	87	89	62, 126, 162, 171	0
All	All	1049/1306 (80%)	0.04	14 (1%)	77	78	29, 69, 149, 173	0

The worst 5 of 14 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
4	D	31	ARG	5.9
3	C	11	ARG	4.6
3	C	12	ALA	4.3
4	D	124	ALA	4.3
4	D	30	LYS	3.8

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 monosaccharides 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(Å^2)	Q<0.9
7	MN	I	1001	1/1	0.16	0.17	161,161,161,161	0
7	MN	I	1004	1/1	0.75	0.09	120,120,120,120	0
7	MN	J	1004	1/1	0.82	0.11	140,140,140,140	0
7	MN	J	1006	1/1	0.88	0.06	127,127,127,127	0
7	MN	J	1005	1/1	0.89	0.12	138,138,138,138	0
7	MN	I	1005	1/1	0.89	0.11	138,138,138,138	0
7	MN	J	1001	1/1	0.90	0.07	142,142,142,142	0
7	MN	J	1007	1/1	0.90	0.10	197,197,197,197	0
6	CL	G	1001	1/1	0.92	0.13	81,81,81,81	0
7	MN	J	1003	1/1	0.92	0.08	201,201,201,201	0
7	MN	I	1003	1/1	0.92	0.09	134,134,134,134	0
6	CL	A	1001	1/1	0.93	0.09	80,80,80,80	0
7	MN	J	1002	1/1	0.96	0.23	100,100,100,100	0
6	CL	E	1001	1/1	0.98	0.13	63,63,63,63	0
7	MN	I	1002	1/1	0.98	0.19	112,112,112,112	0
6	CL	C	1001	1/1	0.98	0.07	65,65,65,65	0
7	MN	E	1002	1/1	0.98	0.31	61,61,61,61	0

6.5 Other polymers (i)

There are no such residues in this entry.