wwPDB X-ray Structure Validation Summary Report (i)

Feb 1, 2016 – 02:09 PM GMT

PDB ID	:	3W96
Title	:	Crystal Structure of Human Nucleosome Core Particle lacking H2A N-terminal region
Authors	:	Iwasaki, W.; Miya, Y.; Horikoshi, N.; Osakabe, A.; Tachiwana, H.; Shibata, T.; Kagawa, W.; Kurumizaka, H.
Deposited on	:	2013-04-01
Resolution	:	3.00 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 (i) symbol.

The following versions of software and data (see references (1)) were used in the production of this report:

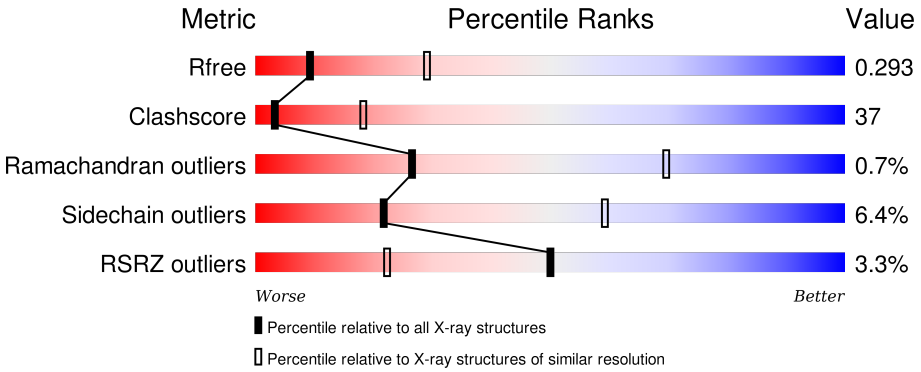
MolProbity	:	4.02b-467
Mogul	:	1.7 (RC4), CSD as536be (2015)
Xtriage (Phenix)	:	1.9-1692
EDS	:	rb-20026688
Percentile statistics	:	20151230.v01 (using entries in the PDB archive December 30th 2015)
Refmac	:	5.8.0135
CCP4	:	6.5.0
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)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

1 Overall quality at a glance (i)

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

The reported resolution of this entry is 3.00 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	1578 (3.00-3.00)
Clashscore	102246	1912 (3.00-3.00)
Ramachandran outliers	100387	1853 (3.00-3.00)
Sidechain outliers	100360	1856 (3.00-3.00)
RSRZ outliers	91569	1592 (3.00-3.00)

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 <=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	31% 37% 31%
1	E	139	45% 24% 29%
2	B	106	41% 26% 6% 27%
2	F	106	47% 28% 23%
3	C	124	47% 32% 7% 14%

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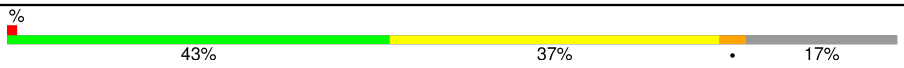
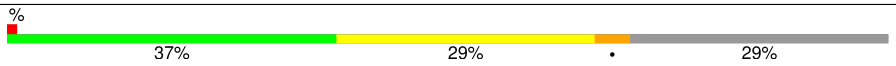
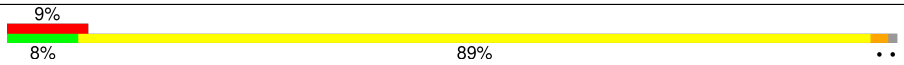
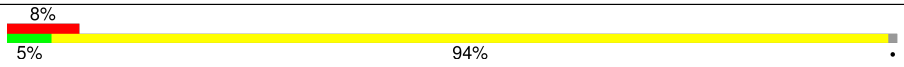
Mol	Chain	Length	Quality of chain
3	G	124	
4	D	129	
4	H	129	
5	I	146	
5	J	146	

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 11890 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	96	Total	C	N	O	S	0	0	0
			794	500	154	136	4			
1	E	98	Total	C	N	O	S	0	0	0
			807	508	156	139	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
			611	387	118	105	1			
2	F	82	Total	C	N	O	S	0	0	0
			657	416	128	112	1			

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
3	C	107	Total	C	N	O	0	0	0
			824	520	161	143			
3	G	103	Total	C	N	O	0	0	0
			796	502	155	139			

There are 8 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
C	6	GLY	-	EXPRESSION TAG	UNP P04908
C	7	SER	-	EXPRESSION TAG	UNP P04908
C	8	HIS	-	EXPRESSION TAG	UNP P04908
C	9	MET	-	EXPRESSION TAG	UNP P04908
G	6	GLY	-	EXPRESSION TAG	UNP P04908
G	7	SER	-	EXPRESSION TAG	UNP P04908
G	8	HIS	-	EXPRESSION TAG	UNP P04908
G	9	MET	-	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	91	Total	C	N	O	S	0	0	0
			714	450	128	134	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			

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Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
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	A	1	Total	Cl	0	0
			1	1		

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

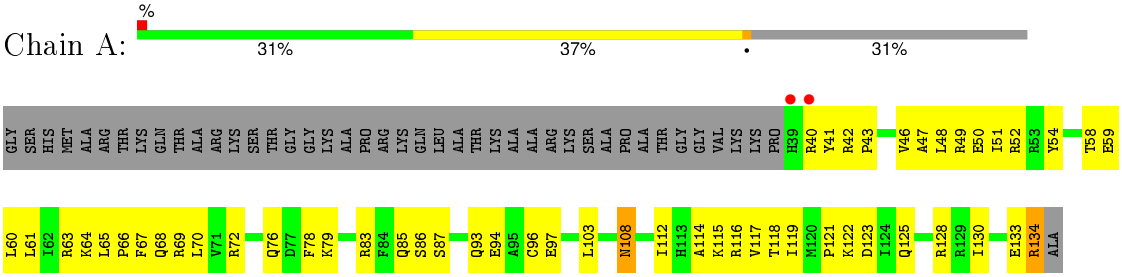
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	I	1	Total	Mn	0	0
			1	1		
7	E	1	Total	Mn	0	0
			1	1		

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 (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.

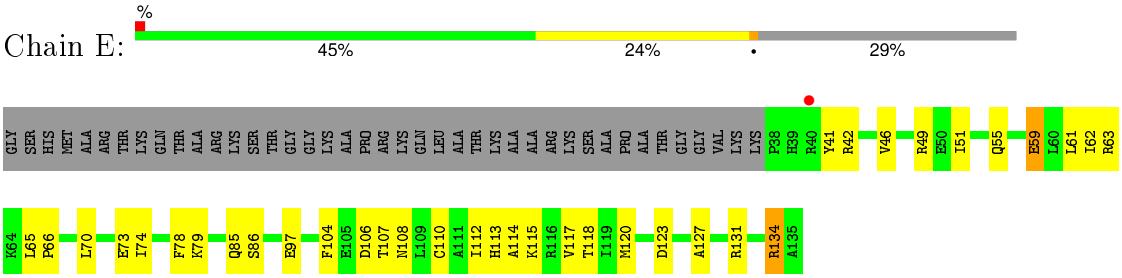
- Molecule 1: Histone H3.1

Chain A:



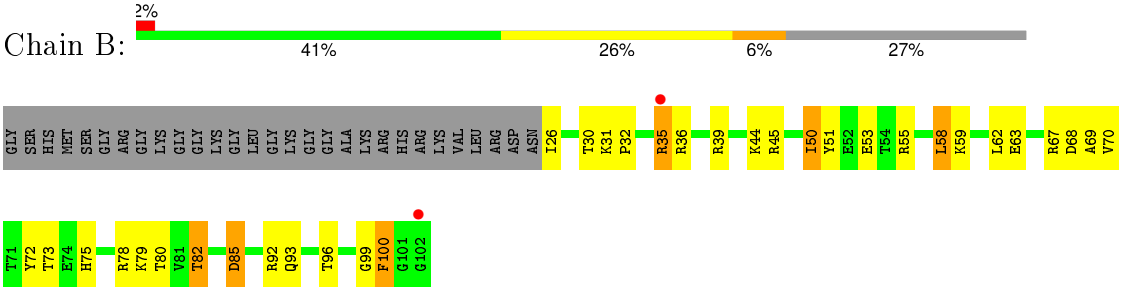
- Molecule 1: Histone H3.1

Chain E:



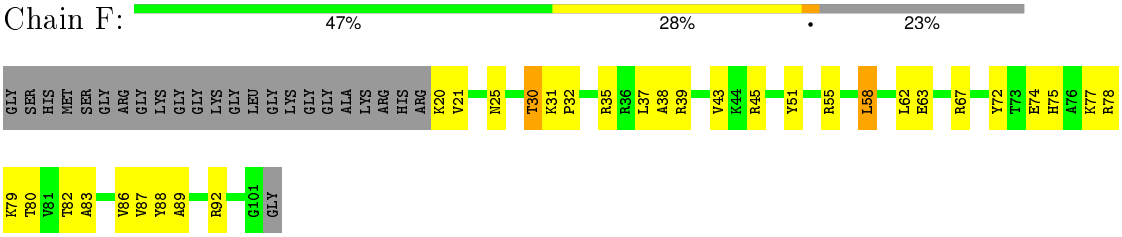
- Molecule 2: Histone H4

Chain B:



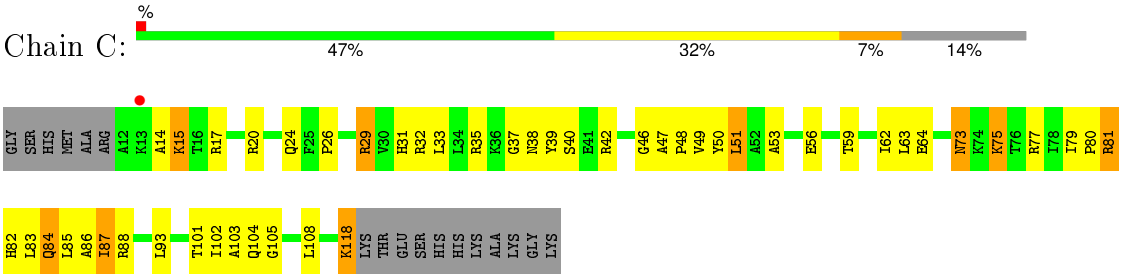
- Molecule 2: Histone H4

Chain F:



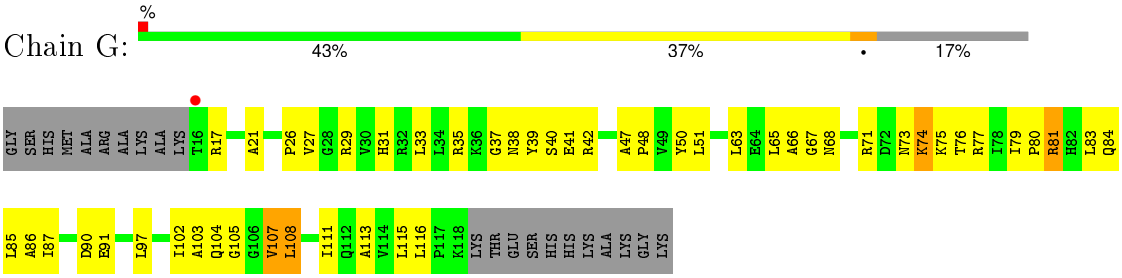
• Molecule 3: Histone H2A type 1-B/E

Chain C:



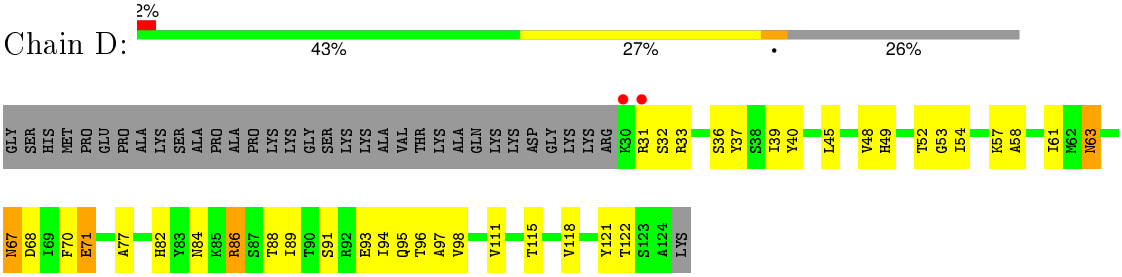
• Molecule 3: Histone H2A type 1-B/E

Chain G:



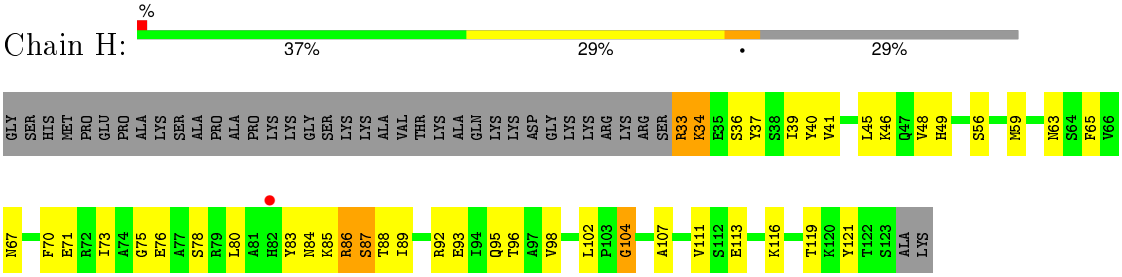
• Molecule 4: Histone H2B type 1-J

Chain D:



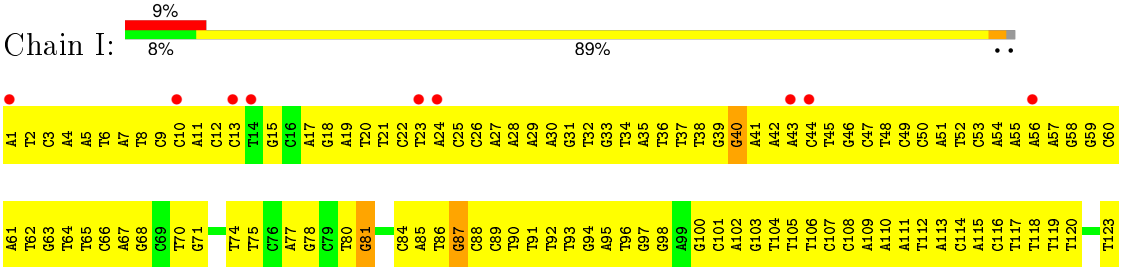
• Molecule 4: Histone H2B type 1-J

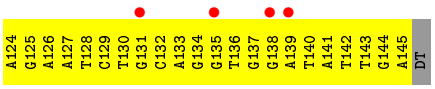
Chain H:



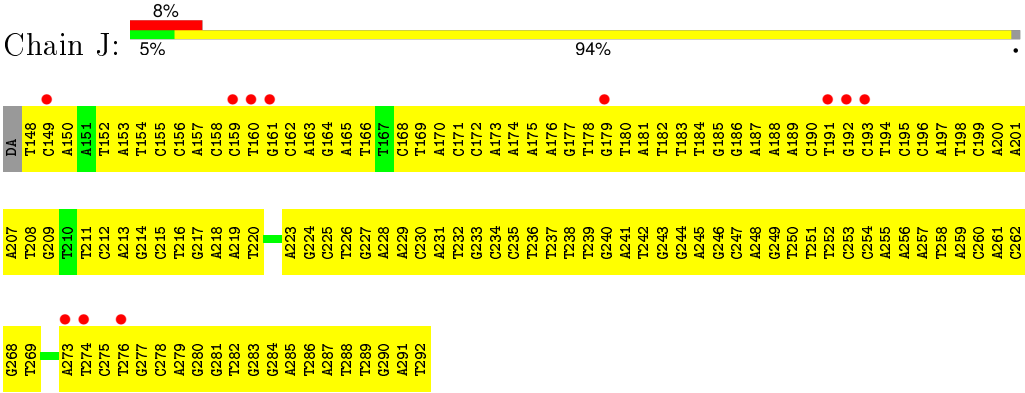
• Molecule 5: 146-mer DNA

Chain I:





- Molecule 5: 146-mer DNA



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	104.52Å 109.32Å 175.66Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	48.44 – 3.00 48.44 – 3.00	Depositor EDS
% Data completeness (in resolution range)	97.6 (48.44-3.00) 97.7 (48.44-3.00)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.07	Depositor
$< I/\sigma(I) >$ [1]	3.76 (at 3.01Å)	Xtriage
Refinement program	CNS 1.2	Depositor
R, R_{free}	0.247 , 0.296 0.247 , 0.293	Depositor DCC
R_{free} test set	2005 reflections (5.02%)	DCC
Wilson B-factor (Å^2)	86.2	Xtriage
Anisotropy	0.735	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.30 , 76.4	EDS
Estimated twinning fraction	0.028 for k,h,-l	Xtriage
L-test for twinning[2]	$< \|L\| > = 0.46$, $< L^2 > = 0.29$	Xtriage
Outliers	0 of 39955 reflections	Xtriage
F_o,F_c correlation	0.92	EDS
Total number of atoms	11890	wwPDB-VP
Average B, all atoms (Å^2)	118.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.76% 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, 0.375 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	0.58	0/805	0.73	0/1079
1	E	0.55	0/819	0.73	0/1097
2	B	0.52	0/618	0.75	0/826
2	F	0.55	0/664	0.78	0/889
3	C	0.49	0/834	0.76	1/1125 (0.1%)
3	G	0.49	0/806	0.76	0/1089
4	D	0.55	0/756	0.71	0/1015
4	H	0.57	0/725	0.75	0/975
5	I	0.60	1/3332 (0.0%)	0.87	3/5141 (0.1%)
5	J	0.46	0/3330	0.80	0/5138
All	All	0.54	1/12689 (0.0%)	0.80	4/18374 (0.0%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	I	87	DG	N9-C4	-5.32	1.33	1.38

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
5	I	40	DG	N9-C4-C5	-6.30	102.88	105.40
5	I	40	DG	C8-N9-C4	5.89	108.75	106.40
3	C	51	LEU	CA-CB-CG	5.79	128.62	115.30
5	I	81	DG	C8-N9-C4	5.01	108.40	106.40

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	794	0	831	73	0
1	E	807	0	844	34	0
2	B	611	0	653	46	0
2	F	657	0	706	32	0
3	C	824	0	884	69	0
3	G	796	0	848	55	0
4	D	745	0	771	56	0
4	H	714	0	735	57	0
5	I	2970	0	1640	235	0
5	J	2969	0	1641	265	0
6	A	1	0	0	1	0
7	E	1	0	0	0	0
7	I	1	0	0	0	0
All	All	11890	0	9553	800	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 37.

The worst 5 of 800 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:J:241:DA:H2"	5:J:242:DT:H5'	1.26	1.14
5:I:43:DA:H2"	5:I:44:DC:H5"	1.30	1.13
5:I:52:DT:H2"	5:I:53:DC:H5'	1.11	1.09
5:J:264:DT:H2"	5:J:265:DT:H5'	1.33	1.08
5:J:277:DG:H2"	5:J:278:DC:H5'	1.34	1.07

There are no symmetry-related clashes.

5.3 Torsion angles

5.3.1 Protein backbone

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	94/139 (68%)	86 (92%)	8 (8%)	0	100 100
1	E	96/139 (69%)	93 (97%)	3 (3%)	0	100 100
2	B	75/106 (71%)	67 (89%)	7 (9%)	1 (1%)	15 53
2	F	80/106 (76%)	75 (94%)	4 (5%)	1 (1%)	15 53
3	C	105/124 (85%)	95 (90%)	10 (10%)	0	100 100
3	G	101/124 (82%)	90 (89%)	10 (10%)	1 (1%)	19 61
4	D	93/129 (72%)	85 (91%)	8 (9%)	0	100 100
4	H	89/129 (69%)	79 (89%)	8 (9%)	2 (2%)	8 38
All	All	733/996 (74%)	670 (91%)	58 (8%)	5 (1%)	26 70

All (5) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
4	H	34	LYS
3	G	74	LYS
2	B	96	THR
2	F	30	THR
4	H	104	GLY

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	84/113 (74%)	79 (94%)	5 (6%)	24 62
1	E	85/113 (75%)	83 (98%)	2 (2%)	57 87
2	B	62/81 (76%)	56 (90%)	6 (10%)	10 37
2	F	68/81 (84%)	67 (98%)	1 (2%)	72 92
3	C	84/97 (87%)	75 (89%)	9 (11%)	8 31

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles
3	G	82/97 (84%)	77 (94%)	5 (6%)	23 61
4	D	81/107 (76%)	76 (94%)	5 (6%)	23 60
4	H	78/107 (73%)	71 (91%)	7 (9%)	12 41
All	All	624/796 (78%)	584 (94%)	40 (6%)	22 59

5 of 40 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
3	C	101	THR
4	D	71	GLU
4	H	86	ARG
4	D	63	ASN
4	D	86	ARG

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 18 such sidechains are listed below:

Mol	Chain	Res	Type
4	D	95	GLN
1	E	68	GLN
3	G	24	GLN
4	D	63	ASN
4	D	67	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)

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

Of 3 ligands modelled in this entry, 3 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^{th} 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	96/139 (69%)	0.10	2 (2%) 67 36	62, 90, 118, 145	0
1	E	98/139 (70%)	0.13	1 (1%) 84 60	58, 79, 112, 128	0
2	B	77/106 (72%)	0.18	2 (2%) 59 29	67, 85, 108, 147	0
2	F	82/106 (77%)	0.21	0 100 100	62, 75, 85, 97	0
3	C	107/124 (86%)	0.11	1 (0%) 85 64	58, 80, 116, 138	0
3	G	103/124 (83%)	-0.01	1 (0%) 84 60	68, 88, 117, 130	0
4	D	95/129 (73%)	0.12	2 (2%) 67 36	61, 83, 119, 162	0
4	H	91/129 (70%)	0.24	1 (1%) 82 58	64, 87, 111, 135	0
5	I	145/146 (99%)	0.60	13 (8%) 12 4	83, 152, 186, 197	0
5	J	145/146 (99%)	0.72	11 (7%) 17 6	88, 151, 192, 199	0
All	All	1039/1288 (80%)	0.28	34 (3%) 50 22	58, 90, 173, 199	0

The worst 5 of 34 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
5	J	161	DG	6.9
5	I	139	DA	4.4
5	I	138	DG	4.1
5	J	160	DT	3.4
5	I	44	DC	3.3

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 (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, 95^{th} 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	1001	1/1	0.95	0.32	4.14	83,83,83,83	0
7	MN	I	1001	1/1	0.74	0.15	-	147,147,147,147	0
6	CL	A	1001	1/1	0.85	0.14	-	103,103,103,103	0

6.5 Other polymers (i)

There are no such residues in this entry.