wwPDB X-ray Structure Validation Summary Report (i)

Oct 31, 2023 – 06:44 AM EDT

PDB ID	:	3LZ0
Title	:	Crystal Structure of Nucleosome Core Particle Composed of the Widom 601 DNA Sequence (orientation 1)
Authors	:	Vasudevan, D.; Chua, E.Y.D.; Davey, C.A.
Deposited on	:	2010-03-01
Resolution	:	2.50 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:

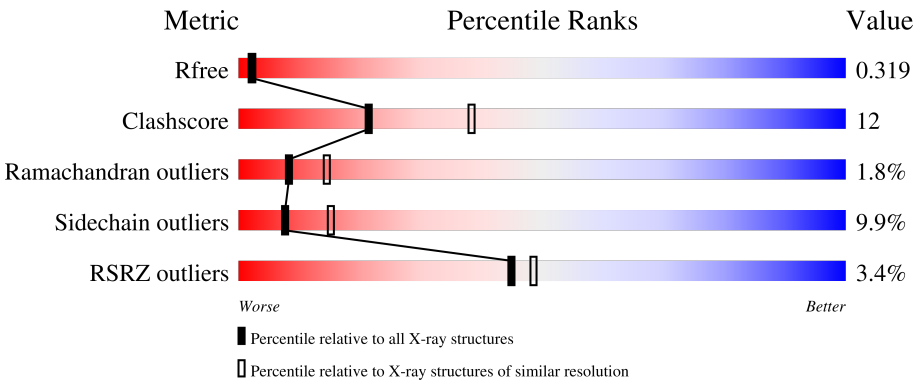
MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.13
EDS	:	2.36
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation 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 2.50 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	4661 (2.50-2.50)
Clashscore	141614	5346 (2.50-2.50)
Ramachandran outliers	138981	5231 (2.50-2.50)
Sidechain outliers	138945	5233 (2.50-2.50)
RSRZ outliers	127900	4559 (2.50-2.50)

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	135	.%, 50%, 17%, •, 28%
1	E	135	8%, 52%, 19%, •, 28%
2	B	102	42%, 34%, 5%, 19%
2	F	102	.%, 61%, 14%, •, 24%
3	C	119	4%, 56%, 25%, 5%, 13%

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Mol	Chain	Length	Quality of chain
3	G	119	3% 50% 34% 12%
4	D	125	5% 44% 26% 5% 24%
4	H	125	4% 44% 28% 26%
5	I	145	47% 38% 15%
6	J	145	% 47% 43% 10%

2 Entry composition (i)

There are 8 unique types of molecules in this entry. The entry contains 11908 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	97	802	506	155	138	3	0	0	0
1	E	97	801	504	155	139	3	0	0	0

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	102	ALA	GLY	SEE REMARK 999	UNP P84233
E	102	ALA	GLY	SEE REMARK 999	UNP P84233

- Molecule 2 is a protein called Histone H4.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	B	83	662	418	129	114	1	0	0	0
2	F	78	619	391	120	107	1	0	0	0

- Molecule 3 is a protein called Histone H2A.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
			Total	C	N	O			
3	C	103	795	501	155	139	0	0	0
3	G	105	809	510	158	141	0	0	0

- Molecule 4 is a protein called Histone H2B 1.1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
4	D	95	745	469	134	140	2	0	0	0

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Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
4	H	93	726	457	130	137	2	0	0	0

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
D	29	THR	SER	SEE REMARK 999	UNP P02281
H	29	THR	SER	SEE REMARK 999	UNP P02281

- Molecule 5 is a DNA chain called DNA (145-MER).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	P			
5	I	145	2952	1404	537	867	144	0	0	0

- Molecule 6 is a DNA chain called DNA (145-MER).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	P			
6	J	145	2987	1416	558	869	144	0	0	0

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

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

- Molecule 8 is CHLORIDE ION (three-letter code: CL) (formula: Cl).

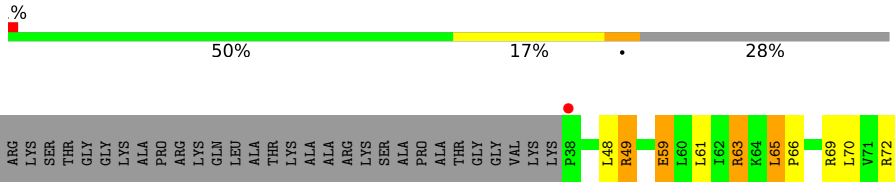
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
			Total	Cl		
8	C	1	1	1	0	0
8	G	1	1	1	0	0

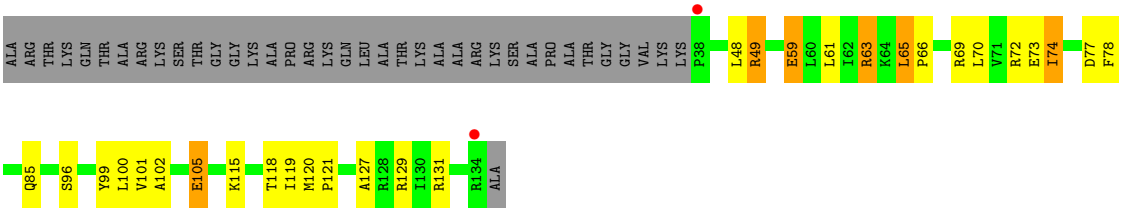
3 Residue-property plots (i)

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 H3.2

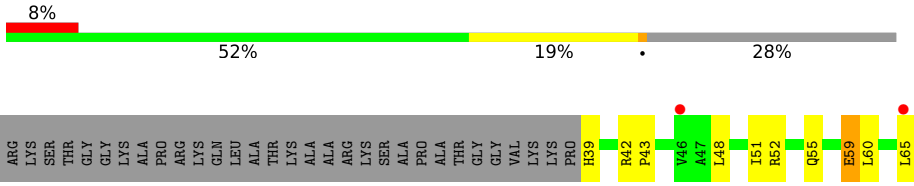
Chain A:

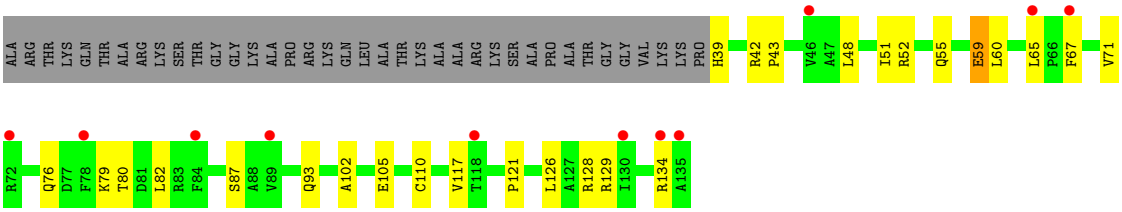




• Molecule 1: Histone H3.2

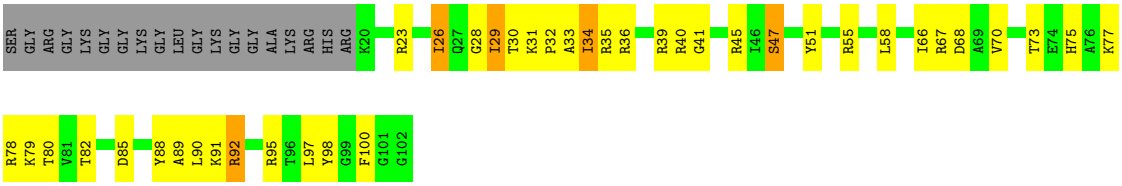
Chain E:





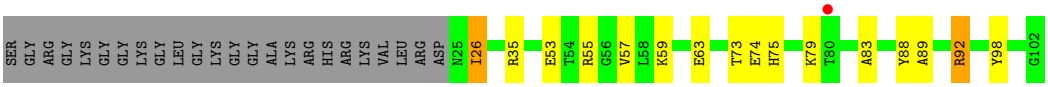
• Molecule 2: Histone H4

Chain B:



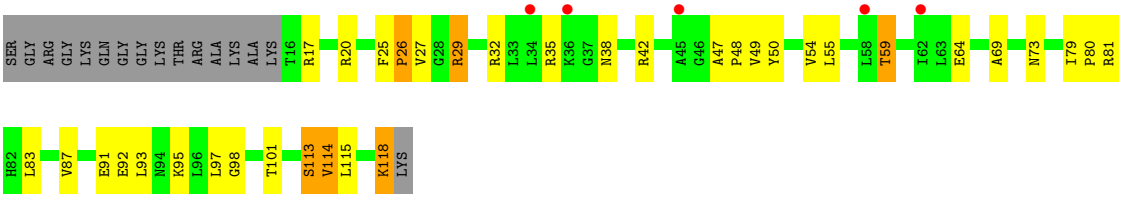
• Molecule 2: Histone H4

Chain F:



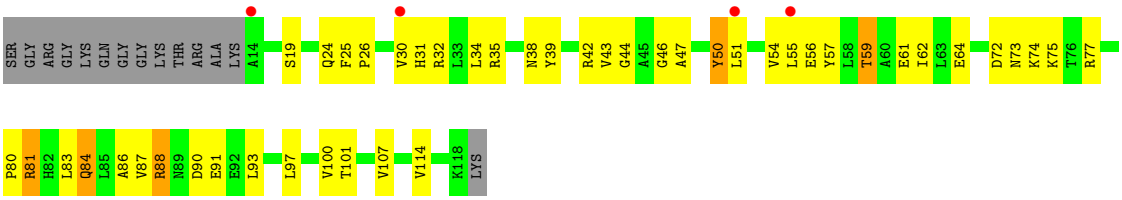
- Molecule 3: Histone H2A

Chain C:



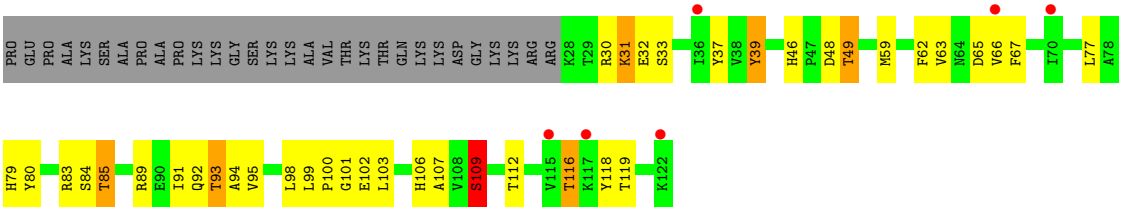
- Molecule 3: Histone H2A

Chain G:



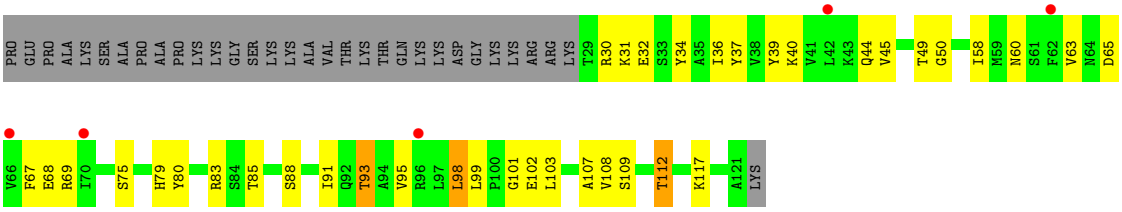
- Molecule 4: Histone H2B 1.1

Chain D:



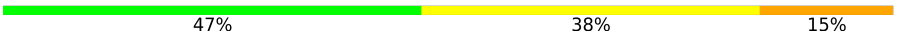
- Molecule 4: Histone H2B 1.1

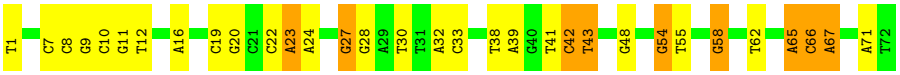
Chain H:



- Molecule 5: DNA (145-MER)

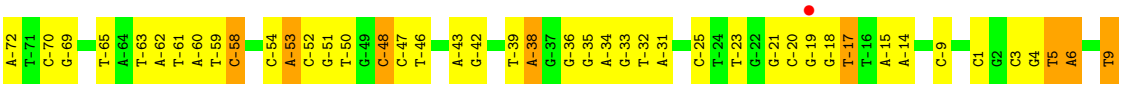
Chain I:

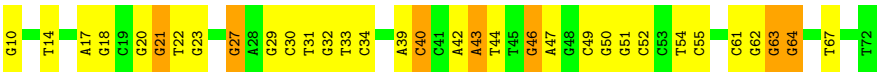




• Molecule 6: DNA (145-MER)

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	107.37Å 109.66Å 175.75Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	93.04 – 2.50 93.04 – 2.50	Depositor EDS
% Data completeness (in resolution range)	90.0 (93.04-2.50) 90.0 (93.04-2.50)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.08	Depositor
$< I/\sigma(I) >$ [1]	1.51 (at 2.51Å)	Xtriage
Refinement program	REFMAC 5.2.0019	Depositor
R, R_{free}	0.268 , 0.318 0.261 , 0.319	Depositor DCC
R_{free} test set	1317 reflections (2.02%)	wwPDB-VP
Wilson B-factor (Å^2)	69.9	Xtriage
Anisotropy	0.650	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.27 , 57.7	EDS
L-test for twinning[2]	$< \|L\| > = 0.47$, $< L^2 > = 0.29$	Xtriage
Estimated twinning fraction	0.000 for k,h,-l	Xtriage
F_o,F_c correlation	0.94	EDS
Total number of atoms	11908	wwPDB-VP
Average B, all atoms (Å^2)	109.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.17% 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	0.66	0/814	0.73	0/1092
1	E	0.41	0/812	0.58	0/1088
2	B	0.67	0/669	0.83	0/894
2	F	0.45	0/626	0.61	0/837
3	C	0.42	0/805	0.61	0/1088
3	G	0.62	0/819	0.76	0/1106
4	D	0.49	0/756	0.64	0/1015
4	H	0.62	0/737	0.70	0/993
5	I	0.73	1/3308 (0.0%)	1.42	43/5099 (0.8%)
6	J	0.72	0/3354	1.44	47/5180 (0.9%)
All	All	0.65	1/12700 (0.0%)	1.16	90/18392 (0.5%)

All (1) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	I	-72	DA	O5'-C5'	9.25	1.65	1.42

The worst 5 of 90 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
6	J	20	DG	O3'-P-O5'	-11.98	81.23	104.00
6	J	20	DG	OP2-P-O3'	-10.01	83.17	105.20
6	J	14	DT	O4'-C1'-N1	8.75	114.12	108.00
6	J	21	DG	O4'-C1'-N9	8.44	113.91	108.00
6	J	34	DC	P-O3'-C3'	8.00	129.31	119.70

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	802	0	841	20	0
1	E	801	0	838	15	0
2	B	662	0	709	37	1
2	F	619	0	659	16	0
3	C	795	0	846	25	0
3	G	809	0	864	47	1
4	D	745	0	773	38	0
4	H	726	0	747	37	0
5	I	2952	0	1629	54	0
6	J	2987	0	1630	47	0
7	A	1	0	0	0	0
7	I	4	0	0	0	0
7	J	3	0	0	0	0
8	C	1	0	0	0	0
8	G	1	0	0	1	0
All	All	11908	0	9536	254	1

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 12.

The worst 5 of 254 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:-72:DA:C5'	5:I:-72:DA:O5'	1.65	1.41
2:B:75:HIS:CD2	4:D:93:THR:HG21	1.58	1.38
2:B:75:HIS:HD2	4:D:93:THR:CG2	1.55	1.17
2:F:75:HIS:CD2	4:H:93:THR:HG21	1.80	1.16
3:C:55:LEU:O	3:C:59:THR:HG22	1.70	0.91

All (1) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:B:23:ARG:NH2	3:G:56:GLU:OE2[3_545]	2.19	0.01

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	95/135 (70%)	83 (87%)	9 (10%)	3 (3%)	4 5
1	E	95/135 (70%)	86 (90%)	9 (10%)	0	100 100
2	B	81/102 (79%)	70 (86%)	8 (10%)	3 (4%)	3 4
2	F	76/102 (74%)	67 (88%)	9 (12%)	0	100 100
3	C	101/119 (85%)	88 (87%)	9 (9%)	4 (4%)	3 3
3	G	103/119 (87%)	88 (85%)	15 (15%)	0	100 100
4	D	93/125 (74%)	81 (87%)	10 (11%)	2 (2%)	6 10
4	H	91/125 (73%)	80 (88%)	10 (11%)	1 (1%)	14 26
All	All	735/962 (76%)	643 (88%)	79 (11%)	13 (2%)	8 14

5 of 13 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	73	GLU
2	B	29	ILE
4	D	101	GLY
1	A	77	ASP
4	D	109	SER

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	85/110 (77%)	77 (91%)	8 (9%)	8 17

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
1	E	84/110 (76%)	79 (94%)	5 (6%)	19	37
2	B	68/78 (87%)	63 (93%)	5 (7%)	13	27
2	F	63/78 (81%)	59 (94%)	4 (6%)	18	34
3	C	82/92 (89%)	75 (92%)	7 (8%)	10	21
3	G	83/92 (90%)	74 (89%)	9 (11%)	6	12
4	D	81/105 (77%)	69 (85%)	12 (15%)	3	5
4	H	79/105 (75%)	67 (85%)	12 (15%)	3	5
All	All	625/770 (81%)	563 (90%)	62 (10%)	8	15

5 of 62 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
4	D	98	LEU
4	H	93	THR
1	E	117	VAL
4	H	88	SER
4	H	109	SER

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 16 such sidechains are listed below:

Mol	Chain	Res	Type
4	H	60	ASN
4	H	44	GLN
1	E	76	GLN
3	G	84	GLN
1	E	68	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 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	97/135 (71%)	0.31	2 (2%) 63 66	51, 68, 92, 106	0
1	E	97/135 (71%)	0.58	11 (11%) 5 4	69, 95, 112, 120	0
2	B	83/102 (81%)	0.28	0 100 100	53, 63, 78, 82	0
2	F	78/102 (76%)	0.40	1 (1%) 77 79	70, 86, 107, 109	0
3	C	103/119 (86%)	0.35	5 (4%) 29 31	70, 85, 107, 110	0
3	G	105/119 (88%)	0.46	4 (3%) 40 43	49, 67, 97, 106	0
4	D	95/125 (76%)	0.44	6 (6%) 20 21	65, 82, 108, 117	0
4	H	93/125 (74%)	0.46	5 (5%) 25 27	57, 74, 91, 103	0
5	I	145/145 (100%)	-0.48	0 100 100	89, 140, 165, 175	0
6	J	145/145 (100%)	-0.53	1 (0%) 87 89	95, 142, 164, 172	0
All	All	1041/1252 (83%)	0.16	35 (3%) 45 48	49, 85, 154, 175	0

The worst 5 of 35 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
3	C	34	LEU	4.9
4	D	122	LYS	4.9
1	E	135	ALA	4.5
1	A	134	ARG	4.1
3	C	36	LYS	4.0

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	J	1006	1/1	-0.10	0.20	159,159,159,159	0
7	MN	I	1003	1/1	0.67	0.23	195,195,195,195	0
7	MN	I	1007	1/1	0.76	0.17	179,179,179,179	0
7	MN	J	1008	1/1	0.89	0.41	222,222,222,222	0
8	CL	C	1101	1/1	0.91	0.12	88,88,88,88	0
7	MN	A	1001	1/1	0.92	0.32	70,70,70,70	0
8	CL	G	1102	1/1	0.92	0.09	88,88,88,88	0
7	MN	I	1005	1/1	0.93	0.30	141,141,141,141	0
7	MN	J	1004	1/1	0.93	0.13	138,138,138,138	0
7	MN	I	1002	1/1	0.95	0.37	174,174,174,174	0

6.5 Other polymers (i)

There are no such residues in this entry.