



wwPDB X-ray Structure Validation Summary Report ⓘ

May 27, 2020 – 03:13 am BST

PDB ID : 5XM1
Title : The mouse nucleosome structure containing H2A, H2B type3-A, H3mm7, and H4
Authors : Taguchi, H.; Horikoshi, N.; Kurumizaka, H.
Deposited on : 2017-05-12
Resolution : 3.45 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 following versions of software and data (see [references ⓘ](#)) were used in the production of this report:

MolProbity : 4.02b-467
Xtriage (Phenix) : 1.13
EDS : 2.11
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) : 2.11

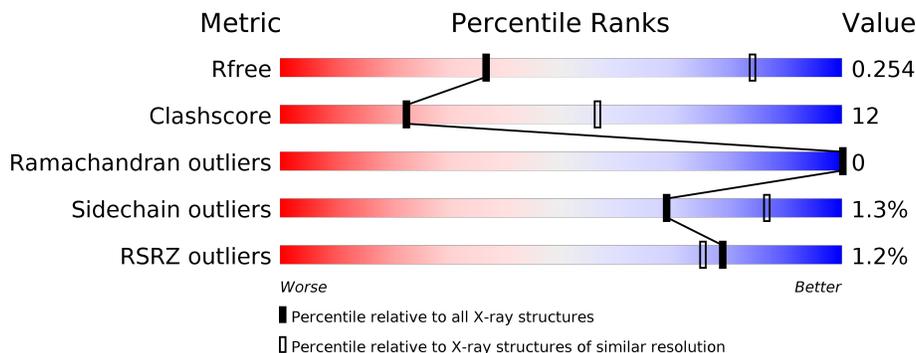
1 Overall quality at a glance i

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.45 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	1291 (3.52-3.40)
Clashscore	141614	1372 (3.52-3.40)
Ramachandran outliers	138981	1337 (3.52-3.40)
Sidechain outliers	138945	1338 (3.52-3.40)
RSRZ outliers	127900	1205 (3.52-3.40)

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 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	139	<div style="display: flex; align-items: center;"> <div style="width: 10px; height: 10px; background-color: red; margin-right: 5px;"></div> <div style="flex-grow: 1; position: relative;"> <div style="position: absolute; top: -10px; left: 0; width: 100%; text-align: center;">%</div> <div style="position: absolute; top: 0; left: 0; width: 63%; height: 10px; background-color: green;"></div> <div style="position: absolute; top: 0; left: 63%; width: 6%; height: 10px; background-color: yellow;"></div> <div style="position: absolute; top: 0; left: 69%; width: 30%; height: 10px; background-color: grey;"></div> </div> </div>
1	E	139	<div style="display: flex; align-items: center;"> <div style="flex-grow: 1; position: relative;"> <div style="position: absolute; top: 0; left: 0; width: 50%; height: 10px; background-color: green;"></div> <div style="position: absolute; top: 0; left: 50%; width: 19%; height: 10px; background-color: yellow;"></div> <div style="position: absolute; top: 0; left: 69%; width: 29%; height: 10px; background-color: grey;"></div> </div> </div>
2	B	106	<div style="display: flex; align-items: center;"> <div style="flex-grow: 1; position: relative;"> <div style="position: absolute; top: 0; left: 0; width: 60%; height: 10px; background-color: green;"></div> <div style="position: absolute; top: 0; left: 60%; width: 13%; height: 10px; background-color: yellow;"></div> <div style="position: absolute; top: 0; left: 73%; width: 26%; height: 10px; background-color: grey;"></div> </div> </div>
2	F	106	<div style="display: flex; align-items: center;"> <div style="width: 10px; height: 10px; background-color: red; margin-right: 5px;"></div> <div style="flex-grow: 1; position: relative;"> <div style="position: absolute; top: -10px; left: 0; width: 100%; text-align: center;">%</div> <div style="position: absolute; top: 0; left: 0; width: 61%; height: 10px; background-color: green;"></div> <div style="position: absolute; top: 0; left: 61%; width: 17%; height: 10px; background-color: yellow;"></div> <div style="position: absolute; top: 0; left: 78%; width: 22%; height: 10px; background-color: grey;"></div> </div> </div>
3	C	133	<div style="display: flex; align-items: center;"> <div style="flex-grow: 1; position: relative;"> <div style="position: absolute; top: 0; left: 0; width: 61%; height: 10px; background-color: green;"></div> <div style="position: absolute; top: 0; left: 61%; width: 17%; height: 10px; background-color: yellow;"></div> <div style="position: absolute; top: 0; left: 78%; width: 21%; height: 10px; background-color: grey;"></div> </div> </div>
3	G	133	<div style="display: flex; align-items: center;"> <div style="flex-grow: 1; position: relative;"> <div style="position: absolute; top: 0; left: 0; width: 57%; height: 10px; background-color: green;"></div> <div style="position: absolute; top: 0; left: 57%; width: 20%; height: 10px; background-color: yellow;"></div> <div style="position: absolute; top: 0; left: 77%; width: 22%; height: 10px; background-color: grey;"></div> </div> </div>

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Mol	Chain	Length	Quality of chain
4	D	129	<p>%</p> <p>50% 22% 27%</p>
4	H	129	<p>55% 16% 29%</p>
5	I	146	<p>3%</p> <p>47% 51%</p>
5	J	146	<p>2%</p> <p>46% 51%</p>

2 Entry composition [i](#)

There are 5 unique types of molecules in this entry. The entry contains 11920 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 H3mm7.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	97	796	503	155	136	2	0	0	0
1	E	98	802	506	156	138	2	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	83	662	418	129	114	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 P62806
B	-2	SER	-	expression tag	UNP P62806
B	-1	HIS	-	expression tag	UNP P62806
F	-3	GLY	-	expression tag	UNP P62806
F	-2	SER	-	expression tag	UNP P62806
F	-1	HIS	-	expression tag	UNP P62806

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

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 C0HKE1
C	-2	SER	-	expression tag	UNP C0HKE1
C	-1	HIS	-	expression tag	UNP C0HKE1
G	-3	GLY	-	expression tag	UNP C0HKE1
G	-2	SER	-	expression tag	UNP C0HKE1
G	-1	HIS	-	expression tag	UNP C0HKE1

- Molecule 4 is a protein called Histone H2B type 3-A.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
4	D	94	Total	C	N	O	S	0	0	0
			736	461	134	139	2			
4	H	91	Total	C	N	O	S	0	0	0
			710	447	125	136	2			

There are 6 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
D	-3	GLY	-	expression tag	UNP Q9D2U9
D	-2	SER	-	expression tag	UNP Q9D2U9
D	-1	HIS	-	expression tag	UNP Q9D2U9
H	-3	GLY	-	expression tag	UNP Q9D2U9
H	-2	SER	-	expression tag	UNP Q9D2U9
H	-1	HIS	-	expression tag	UNP Q9D2U9

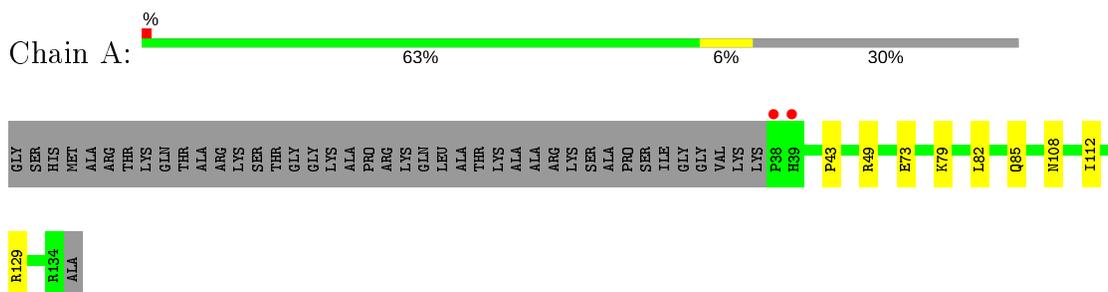
- Molecule 5 is a DNA chain called DNA (146-MER).

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			

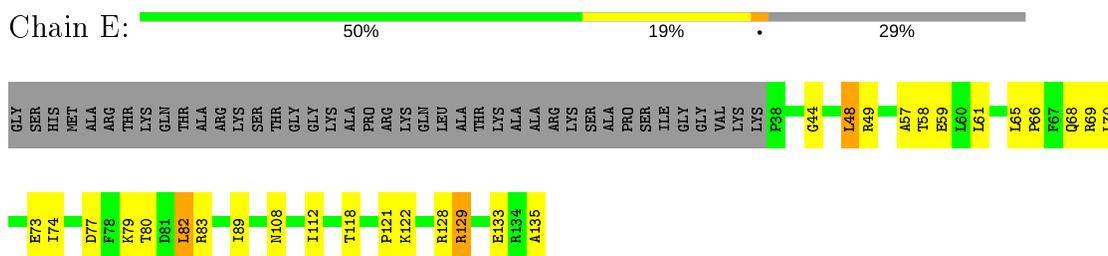
3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA and DNA chains in the entry. The first graphic for a chain summarises the proportions of 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.

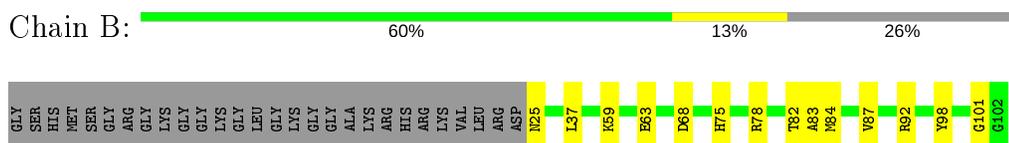
- Molecule 1: Histone H3mm7



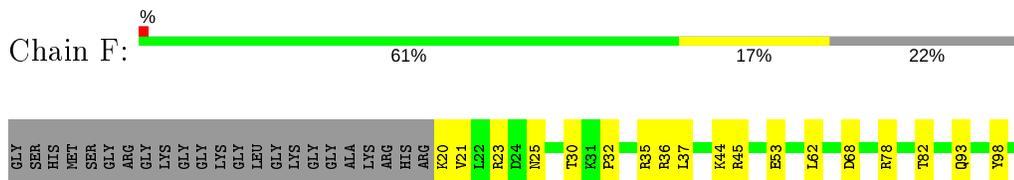
- Molecule 1: Histone H3mm7



- Molecule 2: Histone H4

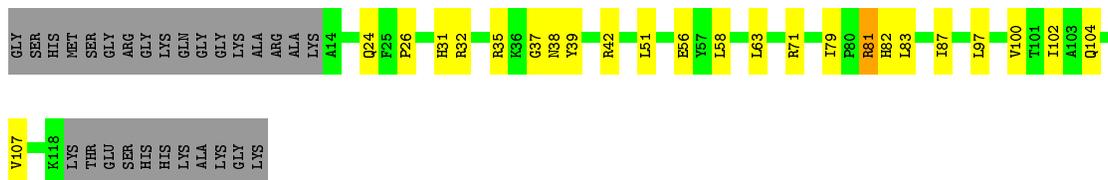


- Molecule 2: Histone H4

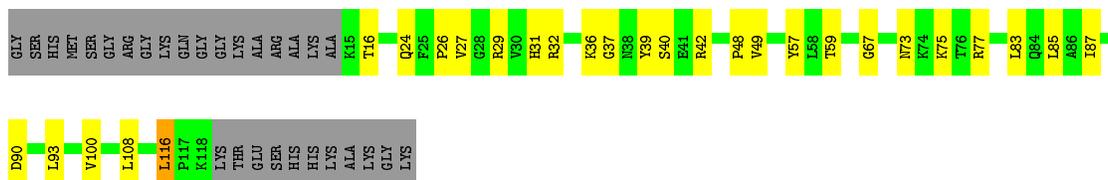


- Molecule 3: Histone H2A type 1-B

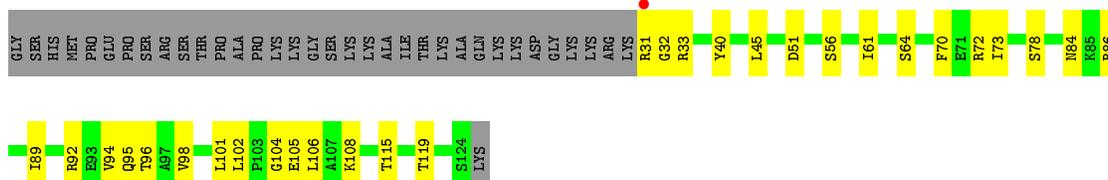




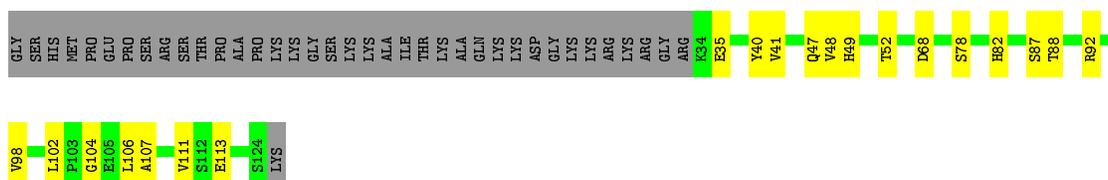
• Molecule 3: Histone H2A type 1-B



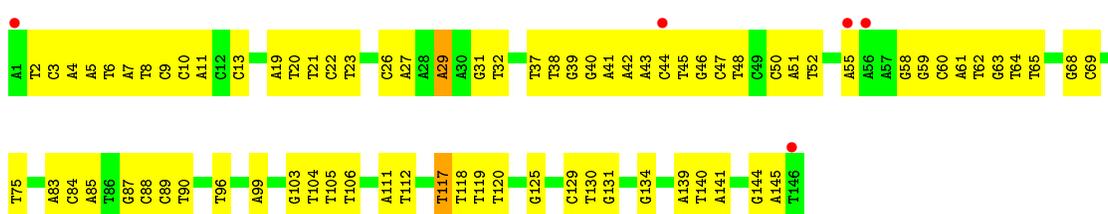
• Molecule 4: Histone H2B type 3-A



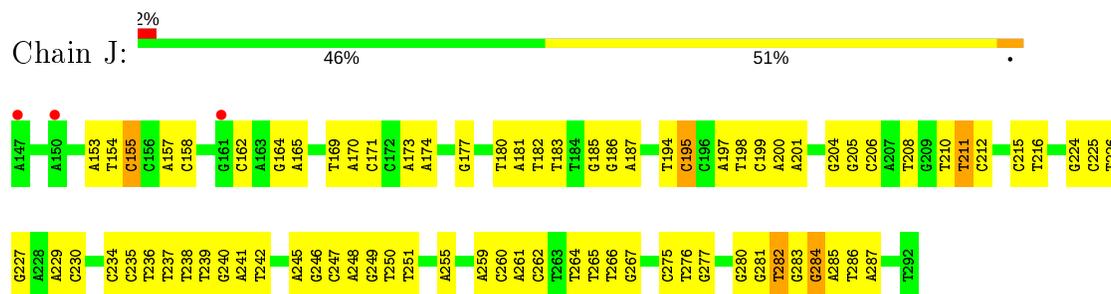
• Molecule 4: Histone H2B type 3-A



• 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	105.55Å 109.38Å 176.21Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	34.88 – 3.45 34.87 – 3.36	Depositor EDS
% Data completeness (in resolution range)	96.5 (34.88-3.45) 93.5 (34.87-3.36)	Depositor EDS
R_{merge}	0.10	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	3.08 (at 3.39Å)	Xtrriage
Refinement program	PHENIX 1.10.1_2155	Depositor
R, R_{free}	0.200 , 0.254 0.200 , 0.254	Depositor DCC
R_{free} test set	1987 reflections (7.16%)	wwPDB-VP
Wilson B-factor (Å ²)	90.8	Xtrriage
Anisotropy	0.688	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.27 , 54.0	EDS
L-test for twinning ²	$\langle L \rangle = 0.46$, $\langle L^2 \rangle = 0.29$	Xtrriage
Estimated twinning fraction	0.027 for k,h,-l	Xtrriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	11920	wwPDB-VP
Average B, all atoms (Å ²)	112.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.96% 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 [i](#)

5.1 Standard geometry [i](#)

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	0/808	0.63	0/1084
1	E	0.68	1/814 (0.1%)	0.90	2/1091 (0.2%)
2	B	0.49	0/626	0.70	0/837
2	F	0.65	0/669	0.78	0/894
3	C	0.58	0/820	0.72	0/1107
3	G	0.49	0/815	0.74	1/1100 (0.1%)
4	D	0.59	0/747	0.75	0/1004
4	H	0.57	0/721	0.68	0/971
5	I	0.85	1/3354 (0.0%)	1.09	8/5175 (0.2%)
5	J	0.89	2/3354 (0.1%)	1.10	6/5175 (0.1%)
All	All	0.74	4/12728 (0.0%)	0.96	17/18438 (0.1%)

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	E	77	ASP	CB-CG	9.05	1.70	1.51
5	J	195	DC	C3'-O3'	-5.71	1.36	1.44
5	I	89	DC	C3'-O3'	-5.14	1.37	1.44
5	J	284	DG	C3'-O3'	-5.10	1.37	1.44

The worst 5 of 17 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	E	77	ASP	CB-CG-OD1	10.73	127.96	118.30
5	J	162	DC	O4'-C4'-C3'	-7.98	101.21	106.00
5	I	83	DA	O5'-P-OP2	-7.96	98.54	105.70
1	E	82	LEU	CA-CB-CG	6.77	130.86	115.30
5	I	134	DG	O4'-C1'-N9	6.55	112.59	108.00

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	796	0	835	6	0
1	E	802	0	840	25	0
2	B	619	0	659	15	0
2	F	662	0	709	15	1
3	C	810	0	866	24	1
3	G	805	0	861	24	0
4	D	736	0	756	24	0
4	H	710	0	727	21	0
5	I	2990	0	1652	79	0
5	J	2990	0	1652	71	0
All	All	11920	0	9557	237	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 237 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:125:DG:N2	5:J:169:DT:O2	2.03	0.91
5:I:55:DA:H61	5:J:238:DT:H3	1.18	0.87
1:E:121:PRO:HB3	2:F:53:GLU:HG3	1.62	0.81
2:F:30:THR:HB	2:F:32:PRO:HD2	1.63	0.80
5:I:11:DA:N6	5:J:282:DT:O4	2.16	0.79

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)
3:C:56:GLU:OE2	2:F:23:ARG:NH2[3_544]	2.15	0.05

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	95/139 (68%)	92 (97%)	3 (3%)	0	100	100
1	E	96/139 (69%)	90 (94%)	6 (6%)	0	100	100
2	B	76/106 (72%)	74 (97%)	2 (3%)	0	100	100
2	F	81/106 (76%)	79 (98%)	2 (2%)	0	100	100
3	C	103/133 (77%)	99 (96%)	4 (4%)	0	100	100
3	G	102/133 (77%)	97 (95%)	5 (5%)	0	100	100
4	D	92/129 (71%)	88 (96%)	4 (4%)	0	100	100
4	H	89/129 (69%)	87 (98%)	2 (2%)	0	100	100
All	All	734/1014 (72%)	706 (96%)	28 (4%)	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	82/111 (74%)	81 (99%)	1 (1%)	71	87
1	E	82/111 (74%)	78 (95%)	4 (5%)	25	57
2	B	63/81 (78%)	63 (100%)	0	100	100
2	F	68/81 (84%)	68 (100%)	0	100	100
3	C	83/102 (81%)	82 (99%)	1 (1%)	71	87
3	G	83/102 (81%)	82 (99%)	1 (1%)	71	87

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles	
4	D	81/110 (74%)	80 (99%)	1 (1%)	71	87
4	H	79/110 (72%)	79 (100%)	0	100	100
All	All	621/808 (77%)	613 (99%)	8 (1%)	69	86

5 of 8 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	E	48	LEU
3	G	90	ASP
1	E	122	LYS
4	D	33	ARG
1	E	82	LEU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
3	C	31	HIS
3	C	73	ASN
4	H	47	GLN
4	H	82	HIS

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 [i](#)

There are no ligands in this entry.

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	97/139 (69%)	0.02	2 (2%) 63 61	64, 83, 118, 151	0
1	E	98/139 (70%)	-0.04	0 100 100	50, 67, 96, 122	0
2	B	78/106 (73%)	-0.11	0 100 100	64, 79, 99, 102	0
2	F	83/106 (78%)	-0.14	1 (1%) 79 75	50, 64, 78, 120	0
3	C	105/133 (78%)	-0.21	0 100 100	54, 71, 96, 126	0
3	G	104/133 (78%)	-0.11	0 100 100	66, 82, 111, 122	0
4	D	94/129 (72%)	-0.19	1 (1%) 80 77	54, 74, 100, 143	0
4	H	91/129 (70%)	-0.07	0 100 100	61, 81, 104, 114	0
5	I	146/146 (100%)	-0.06	5 (3%) 45 43	87, 149, 185, 203	0
5	J	146/146 (100%)	-0.09	3 (2%) 63 61	93, 149, 185, 193	0
All	All	1042/1306 (79%)	-0.10	12 (1%) 79 75	50, 82, 168, 203	0

The worst 5 of 12 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
5	I	146	DT	12.9
5	I	55	DA	5.3
5	I	44	DC	3.4
2	F	102	GLY	3.3
5	J	147	DA	3.0

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

There are no carbohydrates in this entry.

6.4 Ligands

There are no ligands in this entry.

6.5 Other polymers

There are no such residues in this entry.