



# wwPDB X-ray Structure Validation Summary Report ⓘ

Oct 31, 2023 – 06:25 PM JST

PDB ID : 5GT3  
Title : Crystal structure of nucleosome particle in the presence of human testis-specific histone variant, hTh2b  
Authors : Kumarevel, T.; Sivaraman, P.  
Deposited on : 2016-08-18  
Resolution : 2.91 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](mailto: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 types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

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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 : 2.36  
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

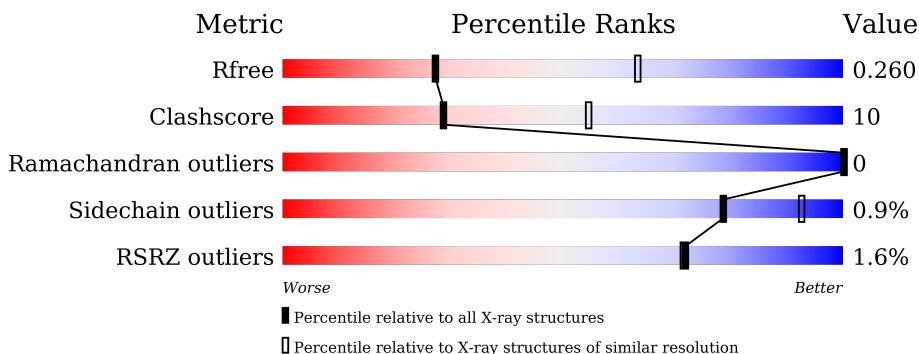
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.91 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.






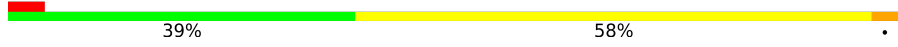
Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
$R_{free}$	130704	2307 (2.94-2.90)
Clashscore	141614	2531 (2.94-2.90)
Ramachandran outliers	138981	2462 (2.94-2.90)
Sidechain outliers	138945	2464 (2.94-2.90)
RSRZ outliers	127900	2248 (2.94-2.90)

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  $\geq 3$ , 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	135	 % 62% 10% • 27%
1	E	135	 61% 11% • 27%
2	B	102	 63% 17% 21%
2	F	102	 % 75% 9% 17%
3	C	129	 % 74% 7% • 18%
3	G	129	 75% 5% 20%

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Mol	Chain	Length	Quality of chain
4	D	126	
4	H	126	
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	CL	I	204	-	-	X	-

## 2 Entry composition [i](#)

There are 8 unique types of molecules in this entry. The entry contains 12041 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	Total 807	C 508	N 156	O 139	S 4	0	0	0
1	E	99	Total 816	C 514	N 158	O 140	S 4	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	81	Total 646	C 407	N 126	O 112	S 1	0	0	0
2	F	85	Total 683	C 430	N 136	O 116	S 1	0	0	0

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

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
			Total	C	N	O			
3	C	106	Total 817	C 517	N 158	O 142	0	0	0
3	G	103	Total 794	C 502	N 153	O 139	0	0	0

- Molecule 4 is a protein called Histone H2B type 1-A.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
4	D	95	Total 749	C 470	N 134	O 143	S 2	0	0	0
4	H	92	Total 720	C 454	N 125	O 139	S 2	0	0	0

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

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

- Molecule 6 is MANGANESE (II) ION (three-letter code: MN) (formula: Mn).

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

- Molecule 7 is CHLORIDE ION (three-letter code: CL) (formula: Cl).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
7	I	2	Total 2	Cl 2	0	0
7	J	3	Total 3	Cl 3	0	0

- Molecule 8 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
8	B	1	Total 1	O 1	0	0
8	C	1	Total 1	O 1	0	0
8	D	2	Total 2	O 2	0	0
8	E	2	Total 2	O 2	0	0
8	F	1	Total 1	O 1	0	0
8	G	1	Total 1	O 1	0	0
8	I	1	Total 1	O 1	0	0

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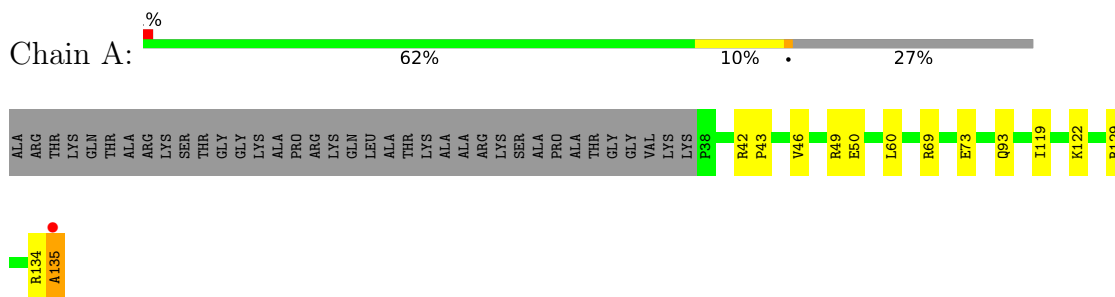
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<b>Mol</b>	<b>Chain</b>	<b>Residues</b>	<b>Atoms</b>		<b>ZeroOcc</b>	<b>AltConf</b>
8	J	3	Total	O	0	0
			3	3		

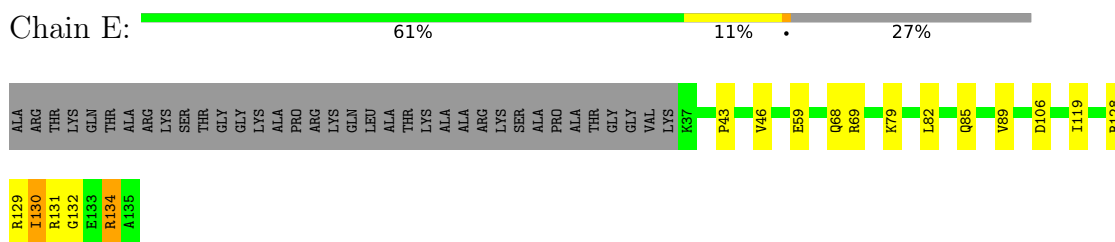
### 3 Residue-property plots [i](#)

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.

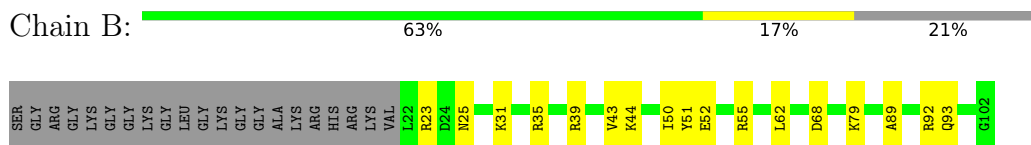
- Molecule 1: Histone H3.1



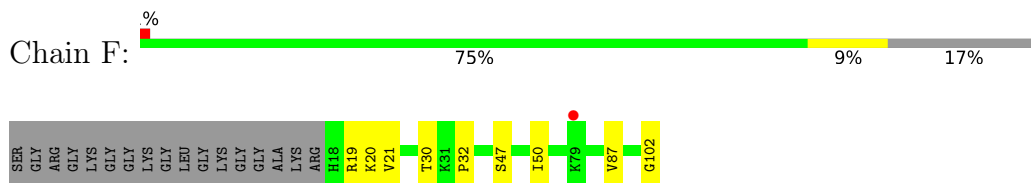
- Molecule 1: Histone H3.1



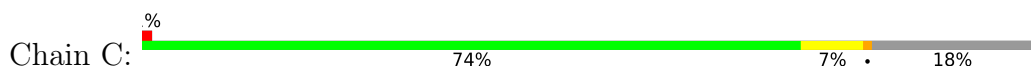
- Molecule 2: Histone H4

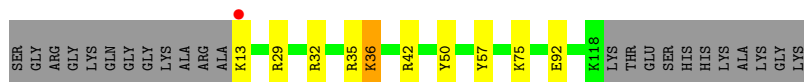


- Molecule 2: Histone H4



- Molecule 3: Histone H2A type 1-D





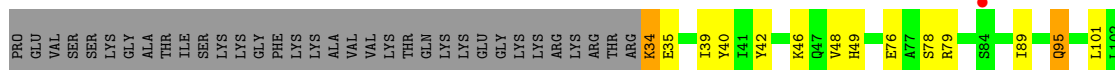
• Molecule 3: Histone H2A type 1-D



• Molecule 4: Histone H2B type 1-A



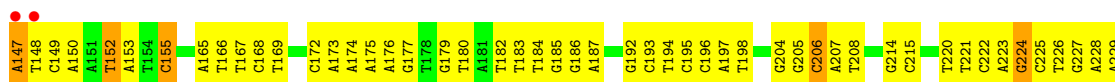
• Molecule 4: Histone H2B type 1-A



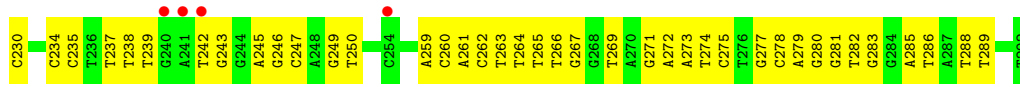
• Molecule 5: DNA (146-MER)



• Molecule 5: DNA (146-MER)







## 4 Data and refinement statistics i

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	106.89Å 110.08Å 182.81Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	34.70 – 2.91 47.27 – 2.90	Depositor EDS
% Data completeness (in resolution range)	96.5 (34.70-2.91) 96.5 (47.27-2.90)	Depositor EDS
$R_{merge}$	0.11	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.56 (at 2.91Å)	Xtrriage
Refinement program	PHENIX 1.8.4_1496	Depositor
R, $R_{free}$	0.200 , 0.258 0.205 , 0.260	Depositor DCC
$R_{free}$ test set	2348 reflections (5.04%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	64.3	Xtrriage
Anisotropy	0.420	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.28 , 49.7	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.31$	Xtrriage
Estimated twinning fraction	0.021 for k,h,-l	Xtrriage
$F_o, F_c$ correlation	0.92	EDS
Total number of atoms	12041	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	77.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.05% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical 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](#)

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

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	0.65	1/819 (0.1%)	0.65	0/1097
1	E	0.73	0/828	0.75	1/1109 (0.1%)
2	B	0.50	0/653	0.68	0/873
2	F	0.67	0/691	0.78	0/923
3	C	0.61	0/827	0.74	0/1115
3	G	0.51	0/804	0.63	0/1086
4	D	0.60	0/760	0.71	0/1019
4	H	0.61	0/731	0.68	0/981
5	I	0.88	3/3354 (0.1%)	1.04	4/5175 (0.1%)
5	J	0.86	4/3354 (0.1%)	1.07	5/5175 (0.1%)
All	All	0.76	8/12821 (0.1%)	0.92	10/18553 (0.1%)

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
4	H	0	1

The worst 5 of 8 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	135	ALA	C-OXT	-9.30	1.05	1.23
5	J	277	DG	C3'-O3'	-8.17	1.33	1.44
5	J	204	DG	C3'-O3'	-7.57	1.34	1.44
5	I	67	DA	C3'-O3'	-6.25	1.35	1.44
5	J	224	DG	C3'-O3'	-6.01	1.36	1.44

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

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
5	J	155	DC	O5'-P-OP1	-8.46	98.09	105.70
5	J	147	DA	O4'-C1'-N9	6.69	112.68	108.00
5	J	245	DA	O4'-C1'-N9	6.43	112.50	108.00
5	J	214	DG	O4'-C1'-N9	-5.76	103.96	108.00
5	I	100	DG	O5'-P-OP2	-5.76	100.52	105.70

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
4	H	34	LYS	Peptide

## 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	17	0
1	E	816	0	856	20	0
2	B	646	0	687	14	0
2	F	683	0	729	7	0
3	C	817	0	879	11	0
3	G	794	0	848	8	0
4	D	749	0	777	14	0
4	H	720	0	744	14	0
5	I	2990	0	1652	67	0
5	J	2990	0	1652	71	0
6	E	1	0	0	0	1
6	G	1	0	0	0	0
6	I	3	0	0	0	0
6	J	7	0	0	0	0
7	I	2	0	0	3	0
7	J	3	0	0	3	0
8	B	1	0	0	0	0
8	C	1	0	0	1	0
8	D	2	0	0	0	1
8	E	2	0	0	0	0
8	F	1	0	0	0	0
8	G	1	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
8	I	1	0	0	0	0
8	J	3	0	0	0	0
All	All	12041	0	9668	200	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 10.

The worst 5 of 200 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:106:ASP:OD2	1:E:131:ARG:NH1	1.93	1.01
5:J:152:DT:H2''	5:J:153:DA:H5''	1.47	0.94
4:D:90:SER:OG	4:D:93:GLU:OE1	1.89	0.89
5:J:182:DT:H2''	5:J:183:DT:H5''	1.62	0.82
5:I:55:DA:H61	5:J:238:DT:H3	1.27	0.81

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)
6:E:201:MN:MN	8:D:201:HOH:O[3_554]	1.64	0.56

## 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	96/135 (71%)	96 (100%)	0	0	100	100
1	E	97/135 (72%)	95 (98%)	2 (2%)	0	100	100
2	B	79/102 (78%)	76 (96%)	3 (4%)	0	100	100
2	F	83/102 (81%)	81 (98%)	2 (2%)	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
3	C	104/129 (81%)	100 (96%)	4 (4%)	0	100	100
3	G	101/129 (78%)	99 (98%)	2 (2%)	0	100	100
4	D	93/126 (74%)	91 (98%)	2 (2%)	0	100	100
4	H	90/126 (71%)	89 (99%)	1 (1%)	0	100	100
All	All	743/984 (76%)	727 (98%)	16 (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	85/110 (77%)	84 (99%)	1 (1%)	71	90
1	E	86/110 (78%)	84 (98%)	2 (2%)	50	79
2	B	66/78 (85%)	66 (100%)	0	100	100
2	F	70/78 (90%)	70 (100%)	0	100	100
3	C	84/99 (85%)	82 (98%)	2 (2%)	49	78
3	G	82/99 (83%)	82 (100%)	0	100	100
4	D	84/110 (76%)	84 (100%)	0	100	100
4	H	81/110 (74%)	80 (99%)	1 (1%)	71	90
All	All	638/794 (80%)	632 (99%)	6 (1%)	78	92

5 of 6 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	E	59	GLU
1	E	134	ARG
4	H	95	GLN
3	C	36	LYS
1	A	122	LYS

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

### 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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	98/135 (72%)	0.07	1 (1%) 82 82	34, 51, 76, 105	0
1	E	99/135 (73%)	-0.02	0 100 100	27, 38, 67, 99	0
2	B	81/102 (79%)	-0.05	0 100 100	38, 49, 66, 103	0
2	F	85/102 (83%)	-0.06	1 (1%) 79 79	27, 38, 58, 100	0
3	C	106/129 (82%)	-0.15	1 (0%) 84 84	28, 44, 72, 102	0
3	G	103/129 (79%)	0.06	0 100 100	34, 52, 77, 86	0
4	D	95/126 (75%)	0.01	0 100 100	29, 45, 74, 113	0
4	H	92/126 (73%)	0.14	1 (1%) 80 81	35, 54, 75, 108	0
5	I	146/146 (100%)	0.24	7 (4%) 30 27	55, 106, 144, 157	0
5	J	146/146 (100%)	0.16	6 (4%) 37 34	62, 106, 140, 148	0
All	All	1051/1276 (82%)	0.06	17 (1%) 72 71	27, 53, 127, 157	0

The worst 5 of 17 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
5	I	146	DT	9.6
5	J	147	DA	6.0
5	I	43	DA	4.3
3	C	13	LYS	3.9
5	I	44	DC	3.9

### 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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
6	MN	J	303	1/1	0.75	0.08	107,107,107,107	0
7	CL	J	309	1/1	0.77	0.08	102,102,102,102	0
6	MN	J	304	1/1	0.80	0.08	114,114,114,114	0
6	MN	I	201	1/1	0.81	0.23	92,92,92,92	0
6	MN	J	306	1/1	0.82	0.13	128,128,128,128	0
6	MN	I	203	1/1	0.83	0.14	112,112,112,112	0
6	MN	J	307	1/1	0.86	0.10	142,142,142,142	0
6	MN	I	202	1/1	0.89	0.19	109,109,109,109	0
7	CL	J	310	1/1	0.89	0.13	119,119,119,119	0
6	MN	J	305	1/1	0.90	0.07	112,112,112,112	0
7	CL	J	308	1/1	0.92	0.10	104,104,104,104	0
7	CL	I	205	1/1	0.94	0.16	80,80,80,80	0
6	MN	J	302	1/1	0.94	0.11	76,76,76,76	0
6	MN	J	301	1/1	0.95	0.23	82,82,82,82	0
7	CL	I	204	1/1	0.95	0.09	91,91,91,91	0
6	MN	E	201	1/1	0.95	0.23	51,51,51,51	0
6	MN	G	201	1/1	0.98	0.14	75,75,75,75	0

### 6.5 Other polymers [i](#)

There are no such residues in this entry.