wwPDB X-ray Structure Validation Summary Report (i)

Oct 31, 2023 – 11:37 AM JST

PDB ID	:	5CPI
Title	:	Nucleosome containing unmethylated Sat2R DNA
Authors	:	Osakabe, A.; Arimura, Y.; Adachi, F.; Maehara, K.; Ohkawa, Y.; Kurumizaka, H.
Deposited on	:	2015-07-21
Resolution	:	2.90 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:

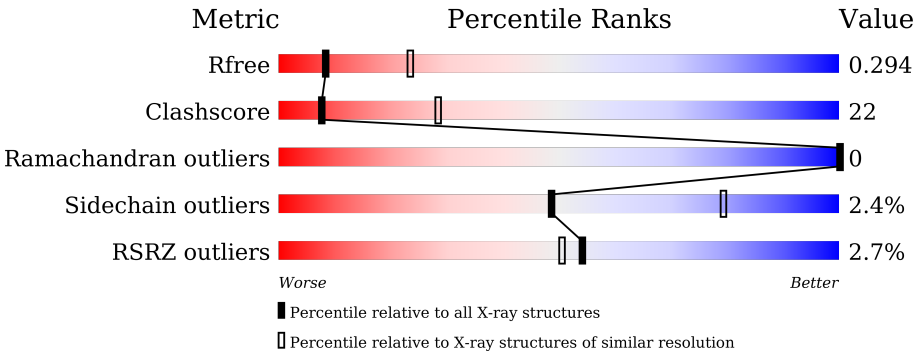
MolProbity	:	4.02b-467
Xtriage (Phenix)	:	1.13
EDS	:	2.36
Percentile statistics	:	20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac	:	5.8.0158
CCP4	:	7.0.044 (Gargrove)
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation 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 2.90 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	1957 (2.90-2.90)
Clashscore	141614	2172 (2.90-2.90)
Ramachandran outliers	138981	2115 (2.90-2.90)
Sidechain outliers	138945	2117 (2.90-2.90)
RSRZ outliers	127900	1906 (2.90-2.90)

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 >=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	4% 40% 26% 30%
1	E	139	2% 37% 31% 29%
2	B	106	2% 51% 21% 26%
2	F	106	% 42% 36% 22%
3	C	133	% 59% 20% 19%
3	G	133	2% 50% 28% 22%

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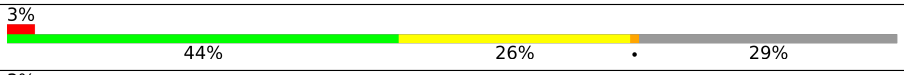
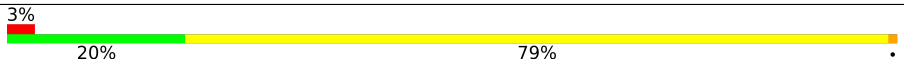
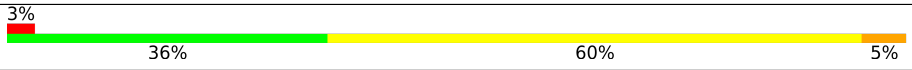
Mol	Chain	Length	Quality of chain
4	D	129	
4	H	129	
5	I	146	
6	J	146	

2 Entry composition (i)

There are 6 unique types of molecules in this entry. The entry contains 11962 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	97	Total	C	N	O	S	0	0	0
			801	505	155	137	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	78	Total	C	N	O	S	0	0	0
			619	391	120	107	1			
2	F	83	Total	C	N	O	S	0	0	0
			668	422	132	113	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	108	Total	C	N	O	0	0	0
			835	526	165	144			
3	G	104	Total	C	N	O	0	0	0
			805	508	157	140			

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
4	D	93	Total	C	N	O	S	0	0	0
			725	456	130	137	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 DNA (146-MER).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
5	I	146	Total	C	N	O	P	0	0	0
			3021	1442	562	871	146			

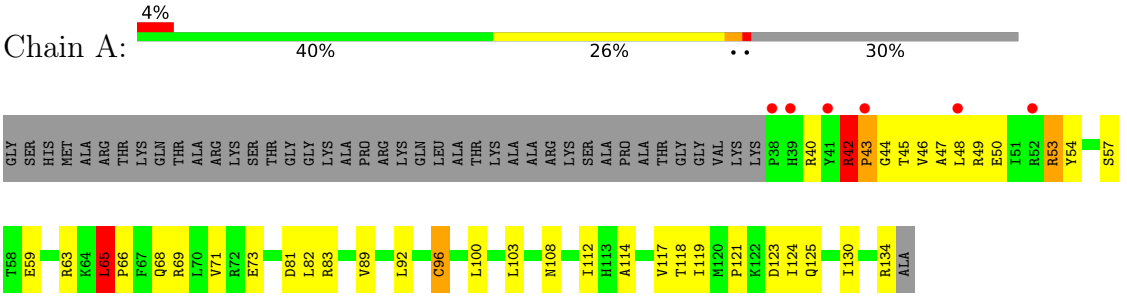
- Molecule 6 is a DNA chain called DNA (146-MER).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	P			
6	J	146	2967	1426	512	883	146	0	0	0

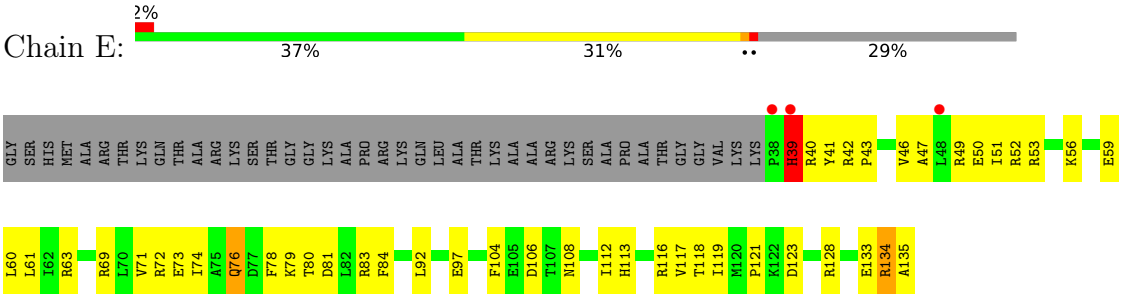
3 Residue-property plots (i)

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.

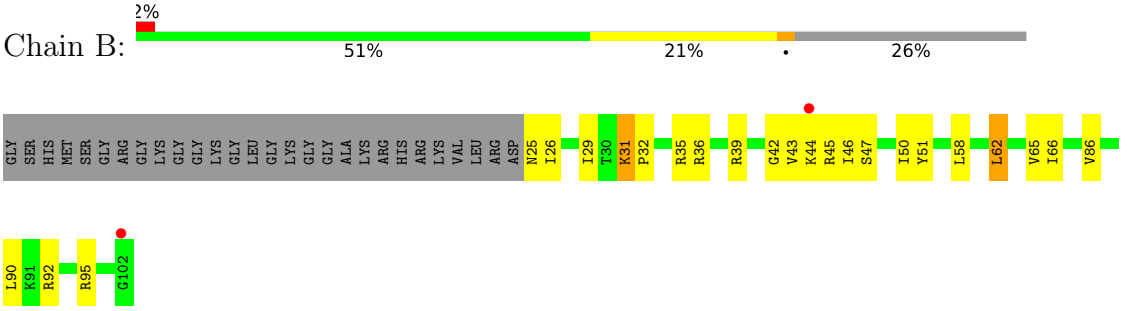
• Molecule 1: Histone H3.1



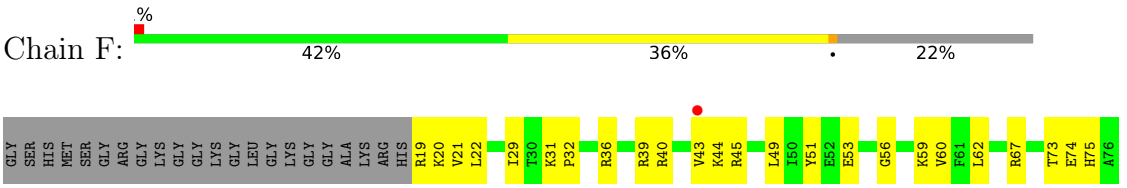
• Molecule 1: Histone H3.1



• Molecule 2: Histone H4

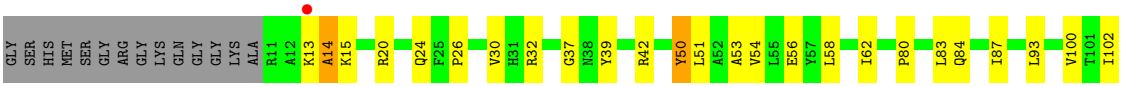


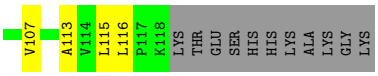
• Molecule 2: Histone H4



• Molecule 3: Histone H2A type 1-B/E

Chain C:





• Molecule 3: Histone H2A type 1-B/E

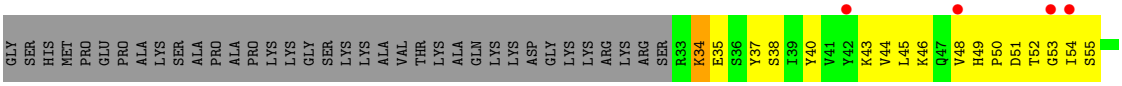
Chain G:

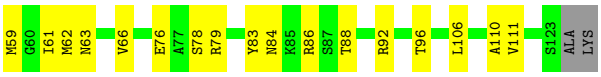
• Molecule 4: Histone H2B type 1-J

Chain D:

• Molecule 4: Histone H2B type 1-J

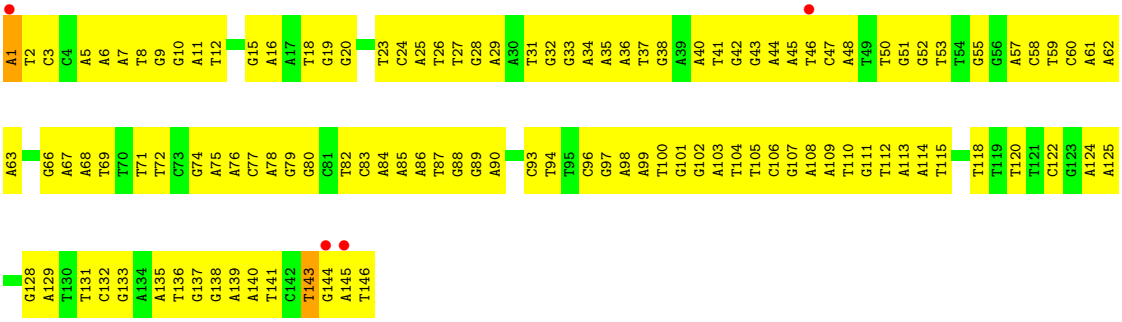
Chain H:



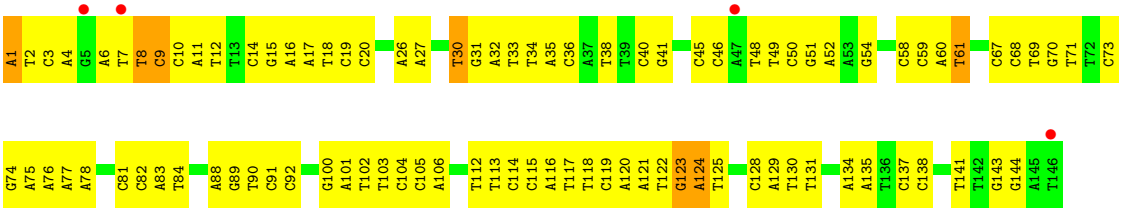


• Molecule 5: DNA (146-MER)

Chain I:



• Molecule 6: DNA (146-MER)



4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	105.43Å 109.33Å 175.77Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	37.95 – 2.90 46.78 – 2.90	Depositor EDS
% Data completeness (in resolution range)	98.3 (37.95-2.90) 97.9 (46.78-2.90)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	2.15 (at 2.91Å)	Xtriage
Refinement program	PHENIX 1.8.4_1496	Depositor
R, R_{free}	0.251 , 0.295 0.252 , 0.294	Depositor DCC
R_{free} test set	1999 reflections (4.45%)	wwPDB-VP
Wilson B-factor (Å^2)	69.8	Xtriage
Anisotropy	0.459	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.26 , 69.4	EDS
L-test for twinning[2]	$< \|L\| > = 0.41$, $< L^2 > = 0.24$	Xtriage
Estimated twinning fraction	0.027 for k,h,-l	Xtriage
F_o,F_c correlation	0.93	EDS
Total number of atoms	11962	wwPDB-VP
Average B, all atoms (Å^2)	123.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.04% 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

5.1 Standard geometry

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	0.57	0/813	0.91	5/1090 (0.5%)
1	E	0.64	0/819	0.90	1/1097 (0.1%)
2	B	0.49	0/626	0.72	1/837 (0.1%)
2	F	0.65	0/675	0.85	1/903 (0.1%)
3	C	0.58	0/845	0.79	1/1139 (0.1%)
3	G	0.49	0/815	0.72	0/1100
4	D	0.53	0/736	0.70	0/990
4	H	0.54	0/725	0.70	0/975
5	I	1.10	2/3396 (0.1%)	1.01	1/5244 (0.0%)
6	J	0.81	3/3320 (0.1%)	1.08	4/5114 (0.1%)
All	All	0.80	5/12770 (0.0%)	0.94	14/18489 (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
1	A	0	1
3	C	0	1
4	H	0	1
All	All	0	3

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	I	1	DA	OP3-P	-11.24	1.47	1.61
6	J	1	DA	OP3-P	-10.52	1.48	1.61
5	I	143	DT	C3'-O3'	8.14	1.54	1.44
6	J	30	DT	C1'-N1	5.65	1.56	1.49
6	J	124	DA	N9-C4	5.50	1.41	1.37

The worst 5 of 14 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	53	ARG	NE-CZ-NH1	-8.95	115.83	120.30
1	A	42	ARG	NE-CZ-NH1	-8.02	116.29	120.30
6	J	123	DG	O4'-C1'-N9	7.58	113.30	108.00
2	F	95	ARG	NE-CZ-NH1	-5.88	117.36	120.30
1	E	39	HIS	C-N-CA	5.84	136.31	121.70

There are no chirality outliers.

All (3) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	43	PRO	Peptide
3	C	14	ALA	Peptide
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	801	0	839	61	0
1	E	807	0	844	51	0
2	B	619	0	659	35	0
2	F	668	0	719	50	0
3	C	835	0	897	27	0
3	G	805	0	861	54	0
4	D	725	0	745	30	0
4	H	714	0	735	47	0
5	I	3021	0	1651	153	0
6	J	2967	0	1657	141	0
All	All	11962	0	9607	469	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 22.

The worst 5 of 469 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)
3:G:77:ARG:NH2	3:G:78:ILE:O	1.89	1.04

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:53:ARG:NH1	6:J:9:DC:OP1	1.99	0.96
4:H:46:LYS:HG3	4:H:50:PRO:HA	1.51	0.92
1:A:42:ARG:HH12	5:I:144:DG:P	1.95	0.89
3:G:77:ARG:NH1	4:H:53:GLY:O	2.08	0.87

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	95/139 (68%)	92 (97%)	3 (3%)	0	100	100
1	E	96/139 (69%)	92 (96%)	4 (4%)	0	100	100
2	B	76/106 (72%)	76 (100%)	0	0	100	100
2	F	81/106 (76%)	79 (98%)	2 (2%)	0	100	100
3	C	106/133 (80%)	105 (99%)	1 (1%)	0	100	100
3	G	102/133 (77%)	100 (98%)	2 (2%)	0	100	100
4	D	91/129 (70%)	89 (98%)	2 (2%)	0	100	100
4	H	89/129 (69%)	88 (99%)	1 (1%)	0	100	100
All	All	736/1014 (73%)	721 (98%)	15 (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	85/113 (75%)	81 (95%)	4 (5%)	26 59
1	E	85/113 (75%)	81 (95%)	4 (5%)	26 59
2	B	63/81 (78%)	60 (95%)	3 (5%)	25 58
2	F	69/81 (85%)	68 (99%)	1 (1%)	67 89
3	C	85/102 (83%)	84 (99%)	1 (1%)	71 91
3	G	83/102 (81%)	83 (100%)	0	100 100
4	D	79/107 (74%)	77 (98%)	2 (2%)	47 78
4	H	78/107 (73%)	78 (100%)	0	100 100
All	All	627/806 (78%)	612 (98%)	15 (2%)	49 79

5 of 15 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
3	C	50	TYR
1	E	134	ARG
4	D	33	ARG
2	F	73	THR
1	E	76	GLN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 6 such sidechains are listed below:

Mol	Chain	Res	Type
1	E	39	HIS
4	H	47	GLN
4	H	49	HIS
3	C	31	HIS
2	B	27	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)

There are no ligands in this entry.

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

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	97/139 (69%)	0.75	6 (6%)	20	16	62, 97, 155, 192	0
1	E	98/139 (70%)	0.22	3 (3%)	49	44	42, 65, 130, 168	0
2	B	78/106 (73%)	0.31	2 (2%)	56	52	55, 86, 114, 127	0
2	F	83/106 (78%)	0.24	1 (1%)	79	79	34, 57, 88, 105	0
3	C	108/133 (81%)	0.16	1 (0%)	84	84	39, 60, 97, 150	0
3	G	104/133 (78%)	0.21	3 (2%)	51	47	57, 86, 128, 145	0
4	D	93/129 (72%)	0.17	0	100	100	36, 62, 97, 147	0
4	H	91/129 (70%)	0.41	4 (4%)	34	30	45, 75, 124, 135	0
5	I	146/146 (100%)	-0.13	4 (2%)	54	50	111, 168, 196, 215	0
6	J	146/146 (100%)	-0.09	4 (2%)	54	50	102, 167, 199, 210	0
All	All	1044/1306 (79%)	0.19	28 (2%)	54	50	34, 87, 190, 215	0

The worst 5 of 28 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	38	PRO	12.4
1	A	39	HIS	6.6
4	H	54	ILE	6.3
5	I	145	DA	5.4
3	C	13	LYS	5.2

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 monosaccharides in this entry.

6.4 Ligands (i)

There are no ligands in this entry.

6.5 Other polymers (i)

There are no such residues in this entry.