



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 6, 2026 – 08:57 AM UTC

PDB ID : 3MVD / pdb_00003mvd
Title : Crystal structure of the chromatin factor RCC1 in complex with the nucleosome core particle
Authors : Makde, R.D.; England, J.R.; Yennawar, H.P.; Tan, S.
Deposited on : 2010-05-04
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 ⓘ 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 ⓘ](#)) were used in the production of this report:

MolProbity	:	4-5-2 with Phenix2.0
Xtriage (Phenix)	:	2.0
EDS	:	3.0
Percentile statistics	:	20250101.v01 (using entries in the PDB archive January 1st 2025)
CCP4	:	9.0.010 (Gargrove)
Density-Fitness	:	1.0.12
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	2.49

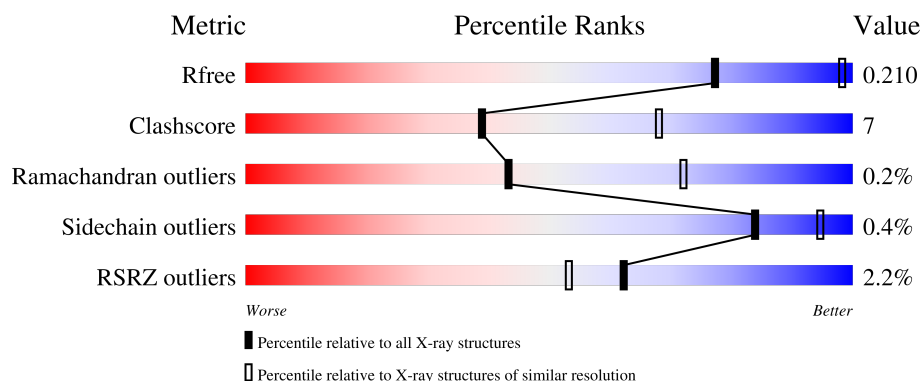
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.90 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.



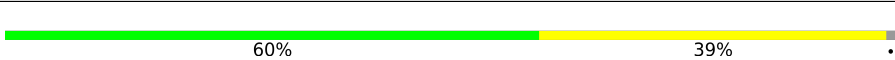
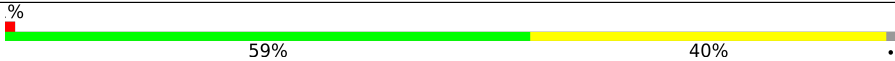
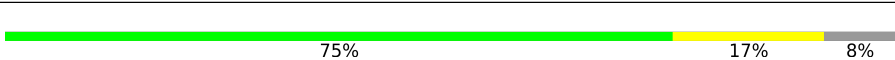
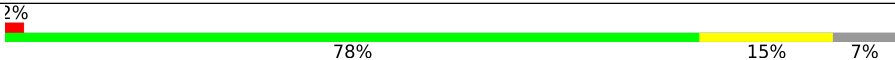
Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	180053	2481 (2.90-2.90)
Clashscore	190562	2690 (2.90-2.90)
Ramachandran outliers	187476	2623 (2.90-2.90)
Sidechain outliers	187428	2625 (2.90-2.90)
RSRZ outliers	180081	2481 (2.90-2.90)

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 $\leq 5\%$. 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	3% 65% 7% 27%
1	E	135	2% 67% . 30%
2	B	102	0% 70% 11% 20%
2	F	102	4% 73% 12% 16%
3	C	129	2% 72% 11% 17%

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Mol	Chain	Length	Quality of chain
3	G	129	
4	D	122	
4	H	122	
5	I	147	
6	J	147	
7	K	423	
7	L	423	

2 Entry composition

There are 7 unique types of molecules in this entry. The entry contains 17743 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
1	A	98	Total	C	N	O	S	0	0	0
			801	506	153	139	3			
1	E	95	Total	C	N	O	S	0	0	0
			779	492	148	136	3			

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
2	B	82	Total	C	N	O	S	0	0	0
			653	413	127	112	1			
2	F	86	Total	C	N	O	S	0	0	0
			672	424	130	117	1			

- Molecule 3 is a protein called Histone H2A.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	C	107	Total	C	N	O		0	0	0
			811	510	158	143				
3	G	107	Total	C	N	O		0	0	0
			815	513	159	143				

- Molecule 4 is a protein called Histone H2B 1.1.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
4	D	93	Total	C	N	O	S	0	0	0
			718	451	128	137	2			

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

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 (146-MER).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
5	I	146	Total	C	N	O	P	0	0	0
			2975	1413	540	876	146			

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

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
6	J	146	Total	C	N	O	P	0	0	0
			3011	1425	564	876	146			

- Molecule 7 is a protein called Regulator of chromosome condensation.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
7	K	391	Total	C	N	O	S	0	0	0
			2893	1802	516	559	16			
7	L	394	Total	C	N	O	S	0	0	0
			2889	1798	515	560	16			

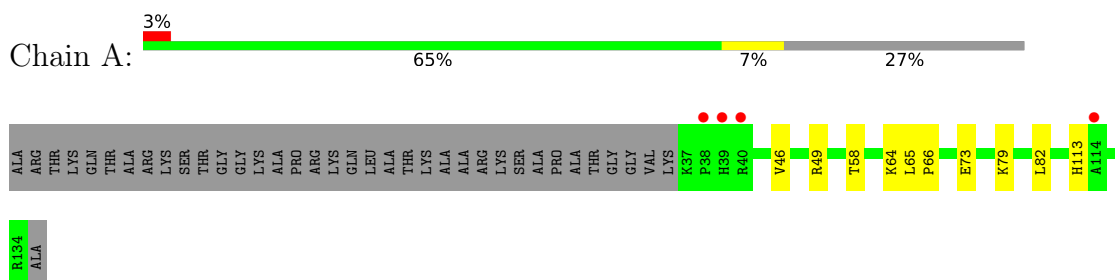
There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
K	0	GLY	-	expression tag	UNP P25171
K	1	SER	-	expression tag	UNP P25171
L	0	GLY	-	expression tag	UNP P25171
L	1	SER	-	expression tag	UNP P25171

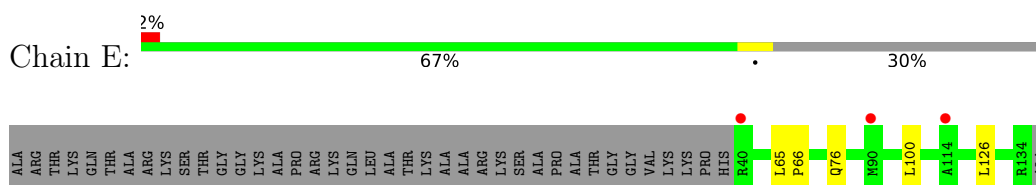
3 Residue-property plots [i](#)

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.

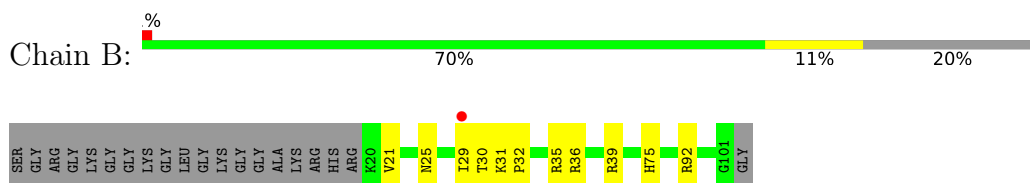
- Molecule 1: Histone H3.2



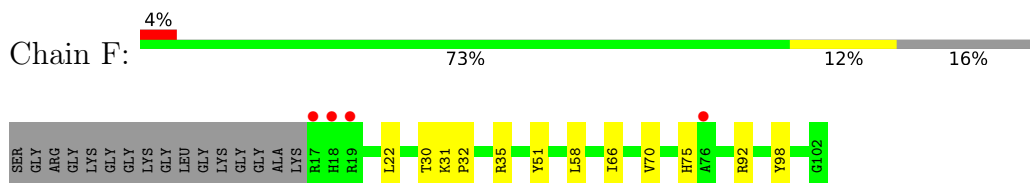
- Molecule 1: Histone H3.2



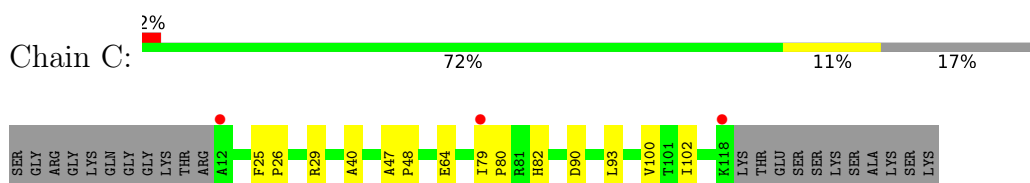
- Molecule 2: Histone H4



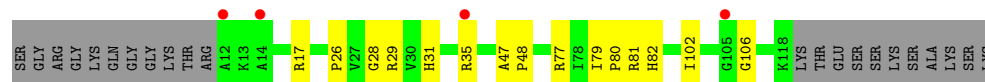
- Molecule 2: Histone H4



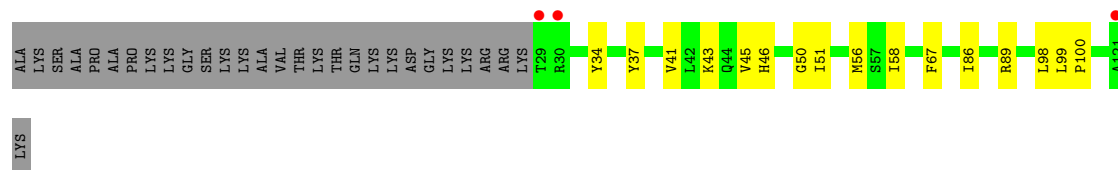
- Molecule 3: Histone H2A



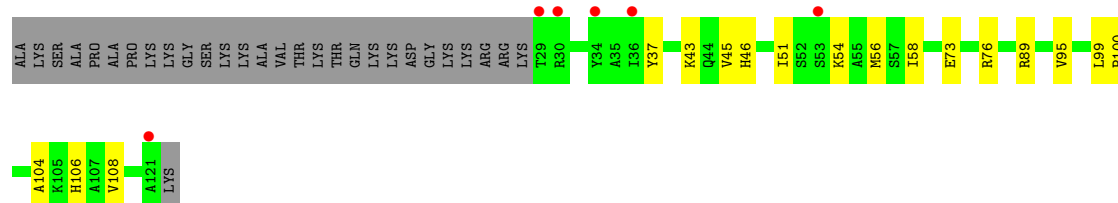
- Molecule 3: Histone H2A



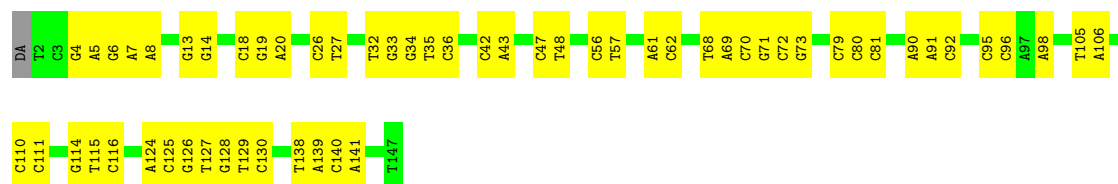
- Molecule 4: Histone H2B 1.1



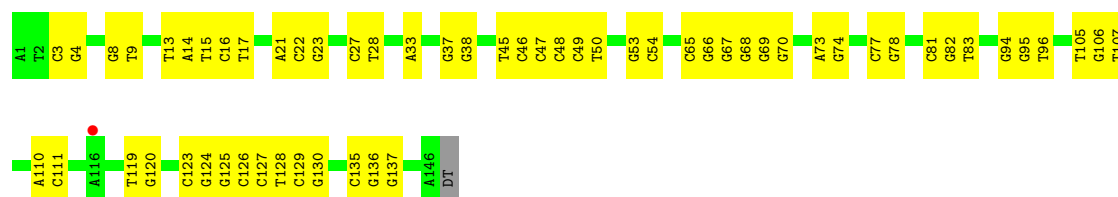
- Molecule 4: Histone H2B 1.1



- Molecule 5: DNA (146-MER)



- Molecule 6: DNA (146-MER)



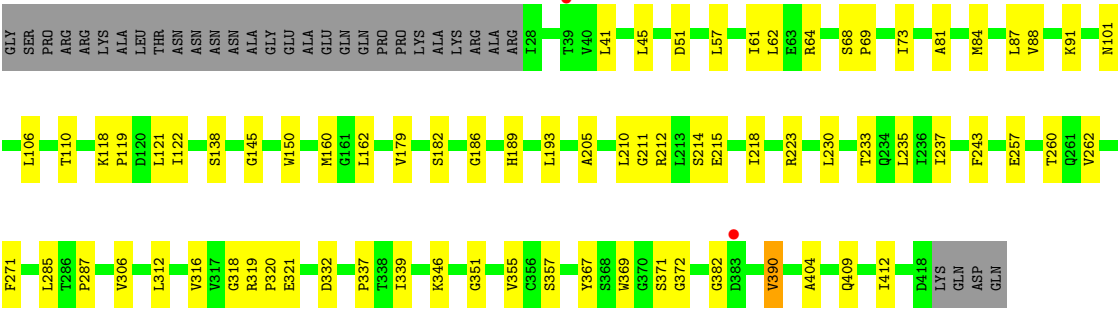
- Molecule 7: Regulator of chromosome condensation

Chain K:

75%

17%

8%



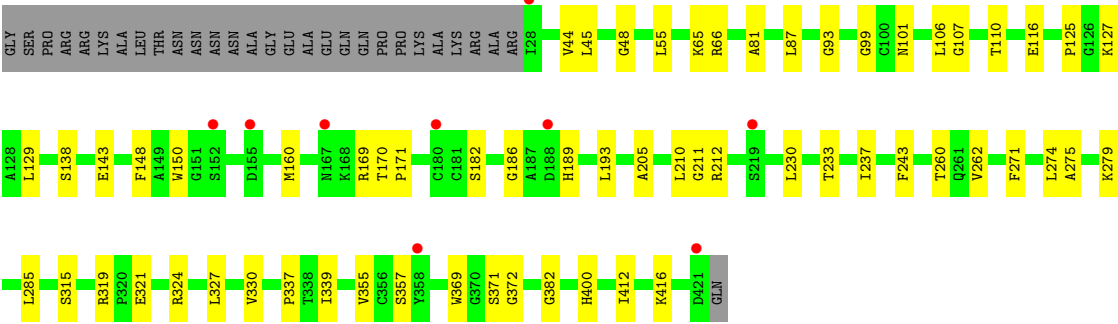
● Molecule 7: Regulator of chromosome condensation

Chain L:

78%

15%

7%



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	102.68Å 183.04Å 107.03Å 90.00° 101.52° 90.00°	Depositor
Resolution (Å)	34.70 – 2.90 34.70 – 2.90	Depositor EDS
% Data completeness (in resolution range)	94.1 (34.70-2.90) 98.5 (34.70-2.90)	Depositor EDS
R_{merge}	0.06	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.34 (at 2.91Å)	Xtriage
Refinement program	PHENIX (phenix.refine: 1.6_289)	Depositor
R, R_{free}	0.175 , 0.215 0.171 , 0.210	Depositor DCC
R_{free} test set	2105 reflections (2.44%)	wwPDB-VP
Wilson B-factor (Å ²)	77.1	Xtriage
Anisotropy	0.434	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.32 , 73.0	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	0.017 for l,-k,h	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	17743	wwPDB-VP
Average B, all atoms (Å ²)	87.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.73% 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	0.26	0/813	0.66	0/1093
1	E	0.27	0/789	0.64	0/1059
2	B	0.26	0/660	0.69	0/885
2	F	0.26	0/680	0.69	0/912
3	C	0.27	0/821	0.66	0/1112
3	G	0.26	0/825	0.68	0/1116
4	D	0.27	0/729	0.70	0/985
4	H	0.27	0/737	0.71	0/993
5	I	0.09	0/3333	0.53	0/5137
6	J	0.09	0/3381	0.54	0/5221
7	K	0.25	0/2938	0.68	0/3975
7	L	0.25	0/2934	0.68	0/3976
All	All	0.21	0/18640	0.63	0/26464

There are no bond length outliers.

There are no bond angle outliers.

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	801	0	831	9	0
1	E	779	0	815	5	0
2	B	653	0	695	10	0
2	F	672	0	698	8	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	C	811	0	849	11	0
3	G	815	0	860	14	0
4	D	718	0	725	14	0
4	H	726	0	747	13	0
5	I	2975	0	1639	37	0
6	J	3011	0	1639	44	0
7	K	2893	0	2871	46	0
7	L	2889	0	2831	36	0
All	All	17743	0	15200	223	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 7.

The worst 5 of 223 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:13:DG:H2''	5:I:14:DG:H5'	1.56	0.87
7:L:87:LEU:HD11	7:L:138:SER:HB3	1.60	0.83
7:L:260:THR:HG23	7:L:262:VAL:H	1.50	0.75
2:F:75:HIS:HA	4:H:89:ARG:HH12	1.52	0.74
5:I:98:DA:H5'	5:I:98:DA:C8	2.22	0.74

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	96/135 (71%)	95 (99%)	1 (1%)	0	100	100
1	E	93/135 (69%)	90 (97%)	3 (3%)	0	100	100
2	B	80/102 (78%)	78 (98%)	2 (2%)	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
2	F	84/102 (82%)	81 (96%)	3 (4%)	0	100	100
3	C	105/129 (81%)	102 (97%)	3 (3%)	0	100	100
3	G	105/129 (81%)	104 (99%)	1 (1%)	0	100	100
4	D	91/122 (75%)	90 (99%)	1 (1%)	0	100	100
4	H	91/122 (75%)	89 (98%)	2 (2%)	0	100	100
7	K	389/423 (92%)	370 (95%)	18 (5%)	1 (0%)	36	65
7	L	392/423 (93%)	370 (94%)	20 (5%)	2 (0%)	24	54
All	All	1526/1822 (84%)	1469 (96%)	54 (4%)	3 (0%)	43	72

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
7	L	279	LYS
7	K	337	PRO
7	L	337	PRO

5.3.2 Protein sidechains ⓘ

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	84/110 (76%)	84 (100%)	0	100	100
1	E	82/110 (74%)	82 (100%)	0	100	100
2	B	67/78 (86%)	66 (98%)	1 (2%)	57	84
2	F	67/78 (86%)	66 (98%)	1 (2%)	57	84
3	C	81/101 (80%)	81 (100%)	0	100	100
3	G	82/101 (81%)	82 (100%)	0	100	100
4	D	77/102 (76%)	77 (100%)	0	100	100
4	H	79/102 (78%)	78 (99%)	1 (1%)	61	86
7	K	308/342 (90%)	306 (99%)	2 (1%)	78	93
7	L	303/342 (89%)	303 (100%)	0	100	100

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Mol	Chain	Analysed	Rotameric	Outliers	Percentiles
All	All	1230/1466 (84%)	1225 (100%)	5 (0%)	84 94

All (5) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	B	21	VAL
2	F	92	ARG
4	H	54	LYS
7	K	339	ILE
7	K	390	VAL

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 23 such sidechains are listed below:

Mol	Chain	Res	Type
4	H	106	HIS
7	K	297	HIS
7	K	234	GLN
7	K	303	HIS
3	C	110	ASN

5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains ⓘ

There are no non-standard protein/DNA/RNA residues in this entry.

5.5 Carbohydrates ⓘ

There are no oligosaccharides in this entry.

5.6 Ligand geometry ⓘ

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 [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	98/135 (72%)	-0.13	4 (4%) 41 33	42, 66, 97, 149	0
1	E	95/135 (70%)	-0.04	3 (3%) 50 41	43, 61, 87, 110	0
2	B	82/102 (80%)	-0.18	1 (1%) 76 69	41, 61, 97, 117	0
2	F	86/102 (84%)	-0.15	4 (4%) 36 28	37, 56, 102, 149	0
3	C	107/129 (82%)	-0.13	3 (2%) 55 46	42, 60, 94, 132	0
3	G	107/129 (82%)	-0.04	4 (3%) 45 37	41, 63, 94, 138	0
4	D	93/122 (76%)	-0.07	3 (3%) 50 41	41, 59, 95, 127	0
4	H	93/122 (76%)	0.02	6 (6%) 25 20	41, 61, 94, 118	0
5	I	146/147 (99%)	0.09	0 100 100	70, 117, 150, 195	0
6	J	146/147 (99%)	0.04	1 (0%) 84 79	70, 112, 152, 183	0
7	K	391/423 (92%)	-0.14	2 (0%) 87 83	47, 73, 107, 134	0
7	L	394/423 (93%)	0.06	9 (2%) 61 52	50, 84, 118, 160	0
All	All	1838/2116 (86%)	-0.04	40 (2%) 62 53	37, 74, 131, 195	0

The worst 5 of 40 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
4	D	29	THR	4.2
7	L	421	ASP	4.1
4	H	121	ALA	4.0
7	L	152	SER	3.8
2	F	19	ARG	3.6

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 oligosaccharides 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.