



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 9, 2026 – 07:54 AM UTC

PDB ID : 1P3G / pdb_00001p3g
Title : Crystallographic Studies of Nucleosome Core Particles containing Histone 'Sin' Mutants
Authors : Muthurajan, U.M.; Bao, Y.; Forsberg, L.J.; Edayathumangalam, R.S.; Dyer, P.N.; White, C.L.; Luger, K.
Deposited on : 2003-04-17
Resolution : 2.70 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) : **NOT EXECUTED**
EDS : **NOT EXECUTED**
Percentile statistics : 20250101.v01 (using entries in the PDB archive January 1st 2025)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.49

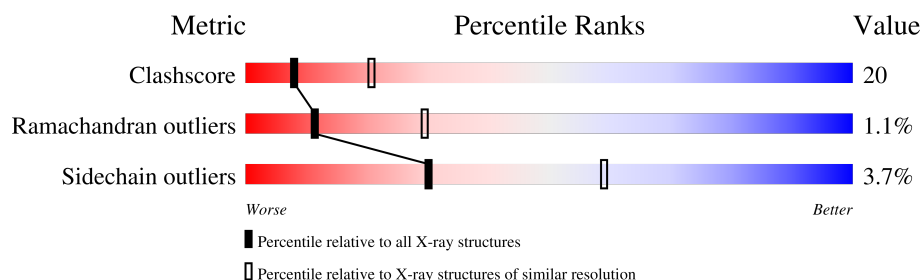
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.70 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))
Clashscore	190562	3843 (2.70-2.70)
Ramachandran outliers	187476	3778 (2.70-2.70)
Sidechain outliers	187428	3778 (2.70-2.70)

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 $\leq 5\%$.

Note EDS was not executed.

Mol	Chain	Length	Quality of chain
1	I	146	40% 52% 8%
1	J	146	32% 64% .
2	A	135	53% 17% . 27%
2	E	135	53% 16% . . 27%
3	B	102	55% 21% . 23%
3	F	102	59% 25% . 15%
4	C	129	63% 15% . 19%
4	G	129	63% 18% . . 16%

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Mol	Chain	Length	Quality of chain
5	D	125	
5	H	125	

2 Entry composition [i](#)

There are 6 unique types of molecules in this entry. The entry contains 12215 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 DNA chain called Palindromic 146bp Human Alpha-Satellite DNA fragment.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	I	146	Total	C	N	O	P	0	0	0
			2990	1430	541	874	145			
1	J	146	Total	C	N	O	P	0	0	0
			2990	1430	541	874	145			

- Molecule 2 is a protein called Histone H3.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	A	98	Total	C	N	O	S	0	0	0
			808	509	156	140	3			
2	E	98	Total	C	N	O	S	0	0	0
			808	509	156	140	3			

There are 6 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	434	GLU	GLY	conflict	UNP Q7ZT64
A	435	SER	VAL	conflict	UNP Q7ZT64
A	502	ALA	GLY	conflict	UNP Q7ZT64
E	634	GLU	GLY	conflict	UNP Q7ZT64
E	635	SER	VAL	conflict	UNP Q7ZT64
E	702	ALA	GLY	conflict	UNP Q7ZT64

- Molecule 3 is a protein called Histone H4.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	B	79	Total	C	N	O	S	0	0	0
			625	394	118	112	1			
3	F	87	Total	C	N	O	S	0	0	0
			701	441	139	120	1			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
B	45	GLU	ARG	conflict	UNP P62799
F	245	GLU	ARG	conflict	UNP P62799

- Molecule 4 is a protein called Histone H2A.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
4	C	104	Total	C	N	O	0	0	0
			800	504	156	140			
4	G	108	Total	C	N	O	0	0	0
			832	525	163	144			

There are 48 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
C	814	ALA	SER	conflict	UNP Q7ZT66
C	867	GLY	TRP	conflict	UNP Q7ZT66
C	868	ASN	GLU	conflict	UNP Q7ZT66
C	869	ALA	ARG	conflict	UNP Q7ZT66
C	870	ALA	LEU	conflict	UNP Q7ZT66
C	871	ARG	PRO	conflict	UNP Q7ZT66
C	872	ASP	GLU	conflict	UNP Q7ZT66
C	873	ASN	ILE	conflict	UNP Q7ZT66
C	874	LYS	TRP	conflict	UNP Q7ZT66
C	876	THR	ARG	conflict	UNP Q7ZT66
C	877	ARG	PRO	conflict	UNP Q7ZT66
C	878	ILE	VAL	conflict	UNP Q7ZT66
C	879	ILE	LEU	conflict	UNP Q7ZT66
C	880	PRO	SER	conflict	UNP Q7ZT66
C	881	ARG	PRO	conflict	UNP Q7ZT66
C	882	HIS	GLY	conflict	UNP Q7ZT66
C	883	LEU	TRP	conflict	UNP Q7ZT66
C	884	GLN	CYS	conflict	UNP Q7ZT66
C	885	LEU	ASN	conflict	UNP Q7ZT66
C	886	ALA	SER	conflict	UNP Q7ZT66
C	887	VAL	LEU	conflict	UNP Q7ZT66
C	888	ARG	CYS	conflict	UNP Q7ZT66
C	923	ALA	SER	conflict	UNP Q7ZT66
C	926	ALA	THR	conflict	UNP Q7ZT66
G	1014	ALA	SER	conflict	UNP Q7ZT66
G	1067	GLY	TRP	conflict	UNP Q7ZT66
G	1068	ASN	GLU	conflict	UNP Q7ZT66
G	1069	ALA	ARG	conflict	UNP Q7ZT66
G	1070	ALA	LEU	conflict	UNP Q7ZT66

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Chain	Residue	Modelled	Actual	Comment	Reference
G	1071	ARG	PRO	conflict	UNP Q7ZT66
G	1072	ASP	GLU	conflict	UNP Q7ZT66
G	1073	ASN	ILE	conflict	UNP Q7ZT66
G	1074	LYS	TRP	conflict	UNP Q7ZT66
G	1076	THR	ARG	conflict	UNP Q7ZT66
G	1077	ARG	PRO	conflict	UNP Q7ZT66
G	1078	ILE	VAL	conflict	UNP Q7ZT66
G	1079	ILE	LEU	conflict	UNP Q7ZT66
G	1080	PRO	SER	conflict	UNP Q7ZT66
G	1081	ARG	PRO	conflict	UNP Q7ZT66
G	1082	HIS	GLY	conflict	UNP Q7ZT66
G	1083	LEU	TRP	conflict	UNP Q7ZT66
G	1084	GLN	CYS	conflict	UNP Q7ZT66
G	1085	LEU	ASN	conflict	UNP Q7ZT66
G	1086	ALA	SER	conflict	UNP Q7ZT66
G	1087	VAL	LEU	conflict	UNP Q7ZT66
G	1088	ARG	CYS	conflict	UNP Q7ZT66
G	1123	ALA	SER	conflict	UNP Q7ZT66
G	1126	ALA	THR	conflict	UNP Q7ZT66

- Molecule 5 is a protein called Histone H2B.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
5	D	93	Total	C	N	O	S	0	0	0
			729	459	131	137	2			
5	H	92	Total	C	N	O	S	0	0	0
			718	453	127	136	2			

There are 8 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
D	1219	GLN	PRO	conflict	UNP P02281
D	1242	LEU	MET	conflict	UNP P02281
D	1257	SER	GLY	conflict	UNP P02281
D	1266	VAL	ILE	conflict	UNP P02281
H	1419	GLN	PRO	conflict	UNP P02281
H	1442	LEU	MET	conflict	UNP P02281
H	1457	SER	GLY	conflict	UNP P02281
H	1466	VAL	ILE	conflict	UNP P02281

- Molecule 6 is water.

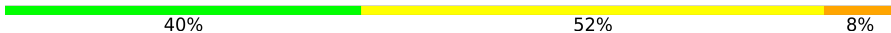
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	I	37	Total 37	O 37	0	0
6	J	40	Total 40	O 40	0	0
6	A	17	Total 17	O 17	0	0
6	B	13	Total 13	O 13	0	0
6	C	20	Total 20	O 20	0	0
6	D	14	Total 14	O 14	0	0
6	E	27	Total 27	O 27	0	0
6	F	20	Total 20	O 20	0	0
6	G	16	Total 16	O 16	0	0
6	H	10	Total 10	O 10	0	0

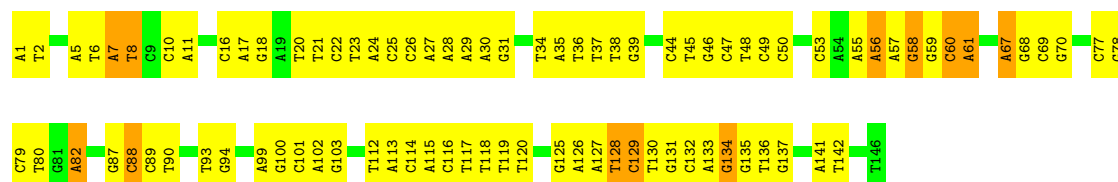
3 Residue-property plots

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. 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. 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.

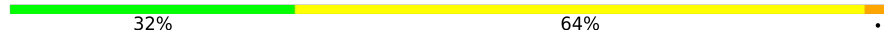
Note EDS was not executed.

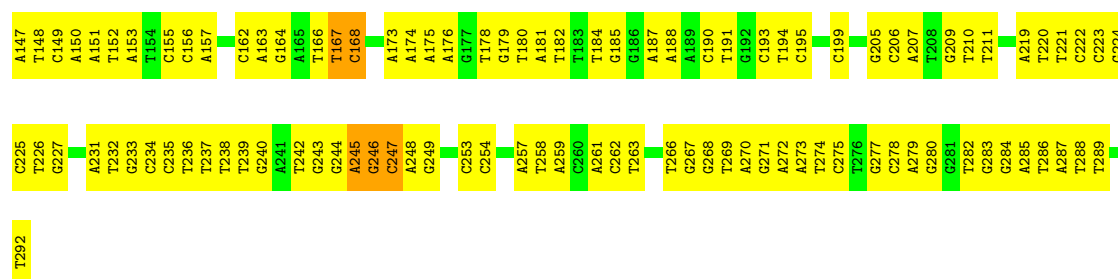
• Molecule 1: Palindromic 146bp Human Alpha-Satellite DNA fragment

Chain I: 



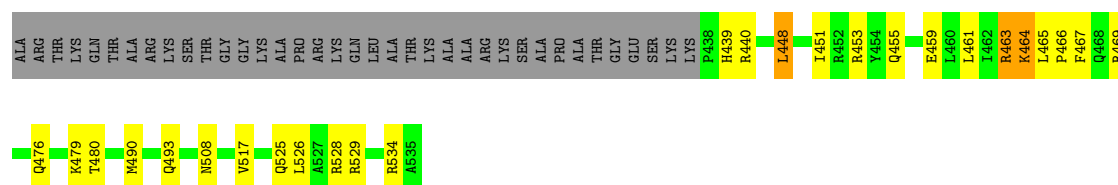
• Molecule 1: Palindromic 146bp Human Alpha-Satellite DNA fragment

Chain J: 



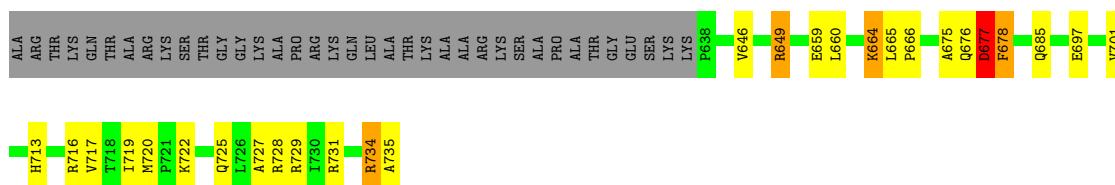
• Molecule 2: Histone H3

Chain A: 



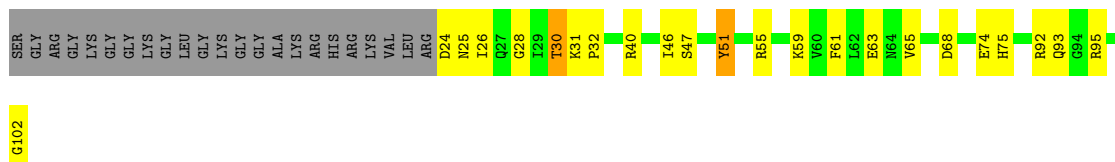
• Molecule 2: Histone H3

Chain E: 



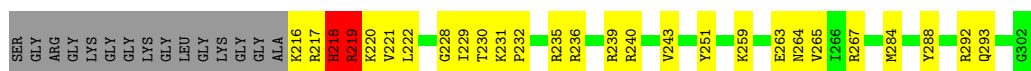
- Molecule 3: Histone H4

Chain B: 55% 21% 0% 23%



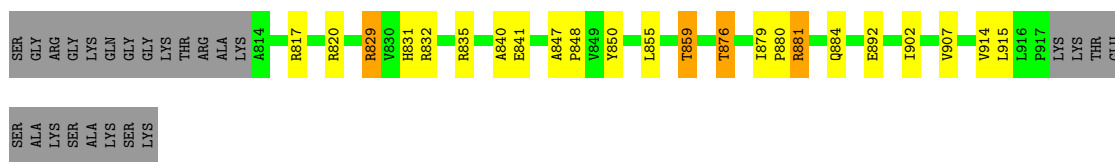
- Molecule 3: Histone H4

Chain F: 59% 25% 0% 15%



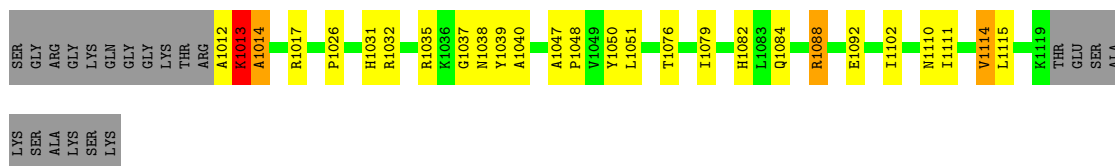
- Molecule 4: Histone H2A

Chain C: 63% 15% 0% 19%



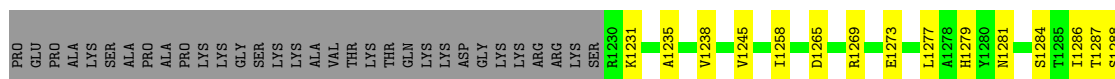
- Molecule 4: Histone H2A

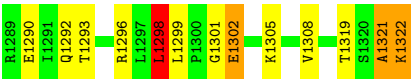
Chain G: 63% 18% 0% 16%



- Molecule 5: Histone H2B

Chain D: 52% 19% 0% 26%





● Molecule 5: Histone H2B



4 Data and refinement statistics

Xtriage (Phenix) and EDS were not executed - this section is therefore incomplete.

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	106.02Å 110.01Å 182.80Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	50.00 – 2.70	Depositor
% Data completeness (in resolution range)	91.4 (50.00-2.70)	Depositor
R_{merge}	0.05	Depositor
R_{sym}	(Not available)	Depositor
Refinement program	CNS	Depositor
R, R_{free}	0.220 , 0.265	Depositor
Estimated twinning fraction	No twinning to report.	Xtriage
Total number of atoms	12215	wwPDB-VP
Average B, all atoms (Å ²)	74.0	wwPDB-VP

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	I	0.49	1/3354 (0.0%)	1.00	19/5175 (0.4%)
1	J	0.37	0/3354	0.86	5/5175 (0.1%)
2	A	0.66	0/820	0.99	2/1099 (0.2%)
2	E	0.81	2/820 (0.2%)	1.03	3/1099 (0.3%)
3	B	0.67	0/632	1.10	3/846 (0.4%)
3	F	0.76	0/709	1.41	7/946 (0.7%)
4	C	0.68	0/810	1.02	0/1095
4	G	0.65	0/842	1.14	5/1135 (0.4%)
5	D	1.14	9/740 (1.2%)	1.37	13/994 (1.3%)
5	H	0.66	0/729	1.00	2/980 (0.2%)
All	All	0.61	12/12810 (0.1%)	1.03	59/18544 (0.3%)

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	I	0	3
1	J	0	2
3	B	0	1
All	All	0	6

The worst 5 of 12 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
5	D	1322	LYS	CB-CG	10.86	1.85	1.52
5	D	1322	LYS	CG-CD	10.10	1.82	1.52
5	D	1322	LYS	CA-CB	9.20	1.71	1.53
5	D	1322	LYS	C-OXT	8.69	1.41	1.23
5	D	1322	LYS	CD-CE	8.41	1.77	1.52

The worst 5 of 59 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	I	59	DG	OP2-P-O3'	-16.08	59.77	108.00
1	J	167	DT	OP2-P-O3'	-15.79	60.64	108.00
3	F	217	ARG	N-CA-C	-15.50	90.07	110.53
1	J	167	DT	O3'-P-O5'	14.15	125.22	104.00
1	J	168	DC	O5'-P-OP2	-13.64	67.08	108.00

There are no chirality outliers.

5 of 6 planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	I	131	DG	Sidechain
1	I	61	DA	Sidechain
1	I	88	DC	Sidechain
1	J	245	DA	Sidechain
1	J	247	DC	Sidechain

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	I	2990	0	1651	133	0
1	J	2990	0	1651	128	0
2	A	808	0	846	29	0
2	E	808	0	846	41	0
3	B	625	0	656	19	0
3	F	701	0	748	24	0
4	C	800	0	851	21	0
4	G	832	0	895	32	0
5	D	729	0	753	30	1
5	H	718	0	740	20	0
6	A	17	0	0	4	0
6	B	13	0	0	2	0
6	C	20	0	0	1	0
6	D	14	0	0	1	0
6	E	27	0	0	12	1
6	F	20	0	0	3	0
6	G	16	0	0	1	0
6	H	10	0	0	0	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
6	I	37	0	0	1	0
6	J	40	0	0	2	0
All	All	12215	0	9637	419	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 20.

The worst 5 of 419 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:D:1322:LYS:CD	5:D:1322:LYS:CG	1.82	1.57
5:D:1322:LYS:CD	5:D:1322:LYS:CE	1.77	1.55
5:D:1322:LYS:CG	5:D:1322:LYS:CB	1.85	1.55
5:D:1322:LYS:CE	5:D:1322:LYS:NZ	1.69	1.52
1:I:88:DC:H4'	1:I:89:DC:OP1	1.41	1.10

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)
5:D:1245:VAL:O	6:E:207:HOH:O[3_544]	2.08	0.12

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	
2	A	96/135 (71%)	93 (97%)	3 (3%)	0	100	100
2	E	96/135 (71%)	92 (96%)	2 (2%)	2 (2%)	5	15
3	B	77/102 (76%)	76 (99%)	1 (1%)	0	100	100
3	F	85/102 (83%)	82 (96%)	1 (1%)	2 (2%)	4	12

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
4	C	102/129 (79%)	97 (95%)	5 (5%)	0	100	100
4	G	106/129 (82%)	97 (92%)	7 (7%)	2 (2%)	6	17
5	D	91/125 (73%)	89 (98%)	1 (1%)	1 (1%)	11	29
5	H	90/125 (72%)	87 (97%)	2 (2%)	1 (1%)	11	29
All	All	743/982 (76%)	713 (96%)	22 (3%)	8 (1%)	11	29

5 of 8 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
5	H	1501	GLY
5	D	1301	GLY
2	E	734	ARG
3	F	219	ARG
4	G	1014	ALA

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	
2	A	85/111 (77%)	82 (96%)	3 (4%)	32	61
2	E	85/111 (77%)	82 (96%)	3 (4%)	32	61
3	B	64/78 (82%)	63 (98%)	1 (2%)	55	80
3	F	72/78 (92%)	70 (97%)	2 (3%)	38	68
4	C	82/100 (82%)	77 (94%)	5 (6%)	17	40
4	G	85/100 (85%)	83 (98%)	2 (2%)	43	72
5	D	79/105 (75%)	76 (96%)	3 (4%)	29	58
5	H	78/105 (74%)	74 (95%)	4 (5%)	21	48
All	All	630/788 (80%)	607 (96%)	23 (4%)	30	59

5 of 23 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	E	678	PHE
4	G	1013	LYS
3	F	219	ARG
4	G	1088	ARG
4	C	876	THR

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 11 such sidechains are listed below:

Mol	Chain	Res	Type
4	G	1104	GLN
5	H	1444	GLN
5	H	1506	HIS
5	H	1492	GLN
3	F	293	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 oligosaccharides 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

EDS was not executed - this section is therefore empty.

6.2 Non-standard residues in protein, DNA, RNA chains

EDS was not executed - this section is therefore empty.

6.3 Carbohydrates

EDS was not executed - this section is therefore empty.

6.4 Ligands

EDS was not executed - this section is therefore empty.

6.5 Other polymers

EDS was not executed - this section is therefore empty.