



wwPDB X-ray Structure Validation Summary Report ⓘ

Feb 1, 2016 – 03:29 PM GMT

PDB ID : 4CBT
Title : Design, synthesis, and biological evaluation of potent and selective Class IIa HDAC inhibitors as a potential therapy for Huntingtons disease
Authors : Burli, R.W.; Luckhurst, C.A.; Aziz, O.; Matthews, K.L.; Yates, D.; Lyons, K.A.; Beconi, M.; McAllister, G.; Breccia, P.; Stott, A.J.; Penrose, S.D.; Wall, M.; Lamers, M.; Leonard, P.; Mueller, I.; Richardson, C.M.; Jarvis, R.; Stones, L.; Hughes, S.; Wishart, G.; Haughan, A.F.; OConnell, C.; Mead, T.; McNeil, H.; Vann, J.; Mangette, J.; Maillard, M.; Beaumont, V.; Munoz-Sanjuan, I.; Dominguez, C.
Deposited on : 2013-10-16
Resolution : 3.03 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
<http://wwpdb.org/validation/2016/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
Mogul : 1.7 (RC4), CSD as536be (2015)
Xtriage (Phenix) : 1.9-1692
EDS : rb-20026688
Percentile statistics : 20151230.v01 (using entries in the PDB archive December 30th 2015)
Refmac : 5.8.0135
CCP4 : 6.5.0
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : trunk26865

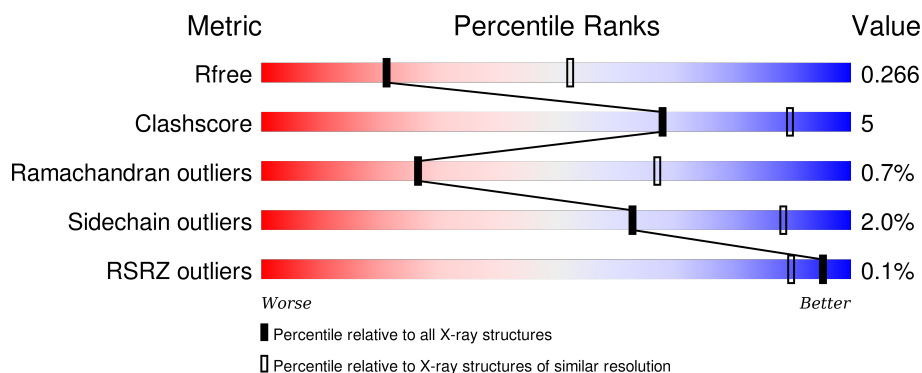
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.03 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}	91344	1995 (3.08-3.00)
Clashscore	102246	2351 (3.08-3.00)
Ramachandran outliers	100387	2272 (3.08-3.00)
Sidechain outliers	100360	2275 (3.08-3.00)
RSRZ outliers	91569	2013 (3.08-3.00)

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. 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	395	
1	B	395	
1	C	395	

2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 7993 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 DEACETYLASE 4.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	349	Total	C	N	O	S	0	0	0
			2638	1660	465	494	19			
1	B	352	Total	C	N	O	S	0	0	0
			2645	1666	461	499	19			
1	C	346	Total	C	N	O	S	0	0	0
			2616	1650	462	485	19			

There are 27 discrepancies between the modelled and reference sequences:

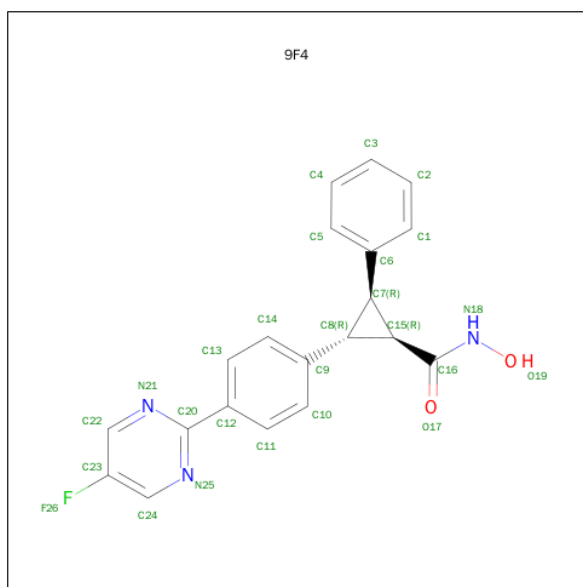
Chain	Residue	Modelled	Actual	Comment	Reference
A	645	MET	-	EXPRESSION TAG	UNP P56524
A	646	GLY	-	EXPRESSION TAG	UNP P56524
A	647	SER	-	EXPRESSION TAG	UNP P56524
A	1034	HIS	-	EXPRESSION TAG	UNP P56524
A	1035	HIS	-	EXPRESSION TAG	UNP P56524
A	1036	HIS	-	EXPRESSION TAG	UNP P56524
A	1037	HIS	-	EXPRESSION TAG	UNP P56524
A	1038	HIS	-	EXPRESSION TAG	UNP P56524
A	1039	HIS	-	EXPRESSION TAG	UNP P56524
B	645	MET	-	EXPRESSION TAG	UNP P56524
B	646	GLY	-	EXPRESSION TAG	UNP P56524
B	647	SER	-	EXPRESSION TAG	UNP P56524
B	1035	HIS	-	EXPRESSION TAG	UNP P56524
B	1036	HIS	-	EXPRESSION TAG	UNP P56524
B	1037	HIS	-	EXPRESSION TAG	UNP P56524
B	1038	HIS	-	EXPRESSION TAG	UNP P56524
B	1039	HIS	-	EXPRESSION TAG	UNP P56524
B	1040	HIS	-	EXPRESSION TAG	UNP P56524
C	645	MET	-	EXPRESSION TAG	UNP P56524
C	646	GLY	-	EXPRESSION TAG	UNP P56524
C	647	SER	-	EXPRESSION TAG	UNP P56524
C	1034	HIS	-	EXPRESSION TAG	UNP P56524
C	1035	HIS	-	EXPRESSION TAG	UNP P56524

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Chain	Residue	Modelled	Actual	Comment	Reference
C	1036	HIS	-	EXPRESSION TAG	UNP P56524
C	1037	HIS	-	EXPRESSION TAG	UNP P56524
C	1038	HIS	-	EXPRESSION TAG	UNP P56524
C	1039	HIS	-	EXPRESSION TAG	UNP P56524

- Molecule 2 is (1R,2R,3R)-2-[4-(5-FLUORANYLPYRIMIDIN-2-YL)PHENYL]-N-OXIDANYL-3-PHENYL-CYCLOPROPANE-1-CARBOXAMIDE (three-letter code: 9F4) (formula: $C_{20}H_{16}FN_3O_2$).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
2	A	1	Total	C	F	N	O	0	0
			26	20	1	3	2		
2	B	1	Total	C	F	N	O	0	0
			26	20	1	3	2		
2	C	1	Total	C	F	N	O	0	0
			26	20	1	3	2		

- Molecule 3 is ZINC ION (three-letter code: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	B	2	Total	Zn	0	0
			2	2		
3	A	2	Total	Zn	0	0
			2	2		
3	C	2	Total	Zn	0	0
			2	2		

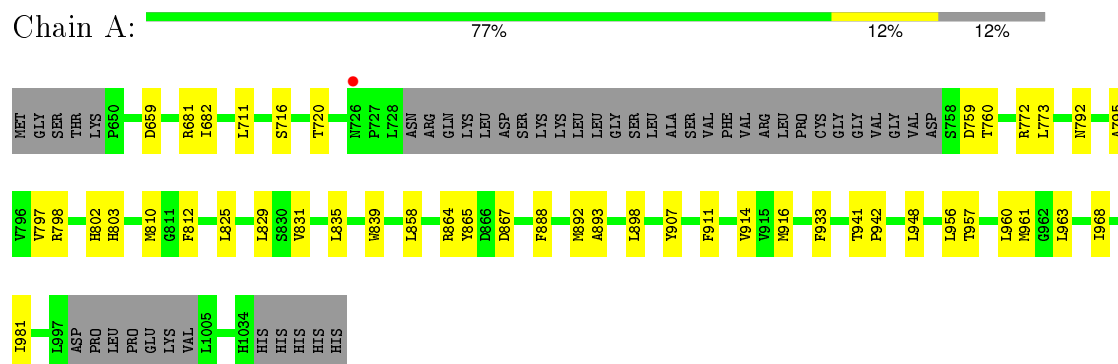
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	5	Total 5	O 5	0	0
4	B	4	Total 4	O 4	0	0
4	C	1	Total 1	O 1	0	0

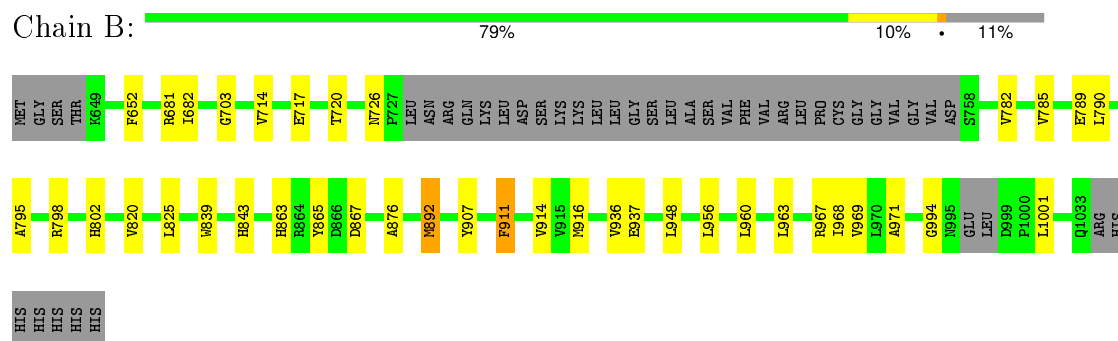
3 Residue-property plots

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

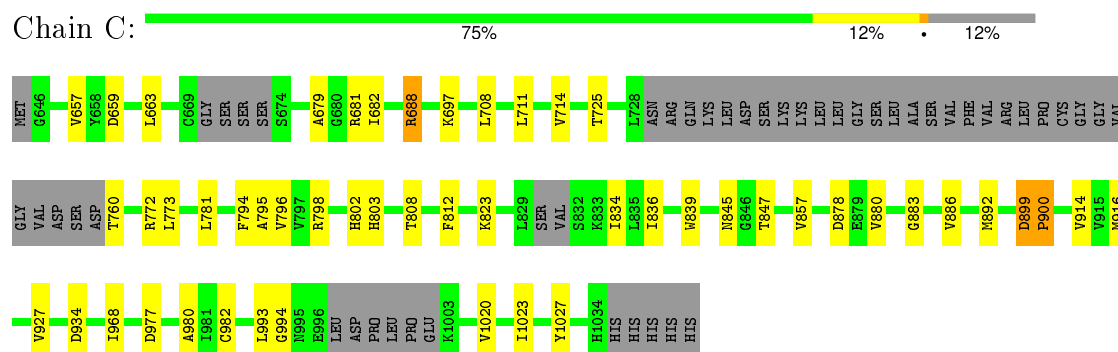
• Molecule 1: HISTONE DEACETYLASE 4



• Molecule 1: HISTONE DEACETYLASE 4



• Molecule 1: HISTONE DEACETYLASE 4



4 Data and refinement statistics

Property	Value	Source
Space group	P 32	Depositor
Cell constants a, b, c, α , β , γ	104.41Å 104.41Å 88.44Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	90.42 – 3.03 90.42 – 3.03	Depositor EDS
% Data completeness (in resolution range)	100.0 (90.42-3.03) 99.8 (90.42-3.03)	Depositor EDS
R_{merge}	0.16	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.51 (at 3.01Å)	Xtriage
Refinement program	REFMAC 5.5.0110	Depositor
R, R_{free}	0.211 , 0.273 0.211 , 0.266	Depositor DCC
R_{free} test set	1070 reflections (5.41%)	DCC
Wilson B-factor (Å ²)	47.8	Xtriage
Anisotropy	0.016	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.30 , 24.0	EDS
Estimated twinning fraction	0.011 for -h,-k,l 0.049 for h,-h-k,-l 0.032 for -k,-h,-l	Xtriage
L-test for twinning ²	$\langle L \rangle = 0.48$, $\langle L^2 \rangle = 0.31$	Xtriage
Outliers	0 of 20863 reflections	Xtriage
F_o, F_c correlation	0.90	EDS
Total number of atoms	7993	wwPDB-VP
Average B, all atoms (Å ²)	38.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 22.14 % of the origin peak, indicating pseudo translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo translational symmetry is equal to 6.0533e-03. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

¹ Intensities estimated from amplitudes.

² Theoretical values of $\langle |L| \rangle$, $\langle L^2 \rangle$ for acentric reflections are 0.5, 0.375 respectively for untwinned datasets, and 0.333, 0.2 for perfectly twinned datasets.

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: 9F4, ZN

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	0.48	0/2699	0.53	1/3661 (0.0%)
1	B	0.43	0/2707	0.53	2/3679 (0.1%)
1	C	0.52	0/2675	0.54	2/3628 (0.1%)
All	All	0.48	0/8081	0.53	5/10968 (0.0%)

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	C	0	1

There are no bond length outliers.

All (5) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	681	ARG	NE-CZ-NH1	7.10	123.85	120.30
1	C	681	ARG	NE-CZ-NH1	6.49	123.55	120.30
1	A	681	ARG	NE-CZ-NH1	6.16	123.38	120.30
1	B	681	ARG	NE-CZ-NH2	-5.92	117.34	120.30
1	C	681	ARG	NE-CZ-NH2	-5.30	117.65	120.30

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	C	899	ASP	Peptide

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	2638	0	2554	25	0
1	B	2645	0	2550	22	0
1	C	2616	0	2537	26	0
2	A	26	0	12	0	0
2	B	26	0	13	0	0
2	C	26	0	12	0	0
3	A	2	0	0	0	0
3	B	2	0	0	0	0
3	C	2	0	0	0	0
4	A	5	0	0	0	0
4	B	4	0	0	0	0
4	C	1	0	0	0	0
All	All	7993	0	7678	73	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 5.

The worst 5 of 73 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:B:785:VAL:HG21	1:B:969:VAL:HG23	1.51	0.91
1:B:785:VAL:HG21	1:B:969:VAL:CG2	2.02	0.88
1:A:825:LEU:HD22	1:A:831:VAL:HG21	1.68	0.73
1:B:916:MET:HE1	1:B:960:LEU:HD23	1.74	0.69
1:B:682:ILE:HD13	1:B:798:ARG:HG2	1.76	0.66

There are no symmetry-related clashes.

5.3 Torsion angles ⓘ

5.3.1 Protein backbone ⓘ

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	343/395 (87%)	318 (93%)	23 (7%)	2 (1%)	30	70
1	B	346/395 (88%)	325 (94%)	18 (5%)	3 (1%)	21	61
1	C	336/395 (85%)	306 (91%)	28 (8%)	2 (1%)	30	70
All	All	1025/1185 (86%)	949 (93%)	69 (7%)	7 (1%)	26	67

5 of 7 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	652	PHE
1	C	900	PRO
1	A	942	PRO
1	B	994	GLY
1	A	941	THR

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	279/322 (87%)	273 (98%)	6 (2%)	60	87
1	B	280/322 (87%)	274 (98%)	6 (2%)	61	88
1	C	275/322 (85%)	270 (98%)	5 (2%)	66	90
All	All	834/966 (86%)	817 (98%)	17 (2%)	63	88

5 of 17 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	802	HIS
1	B	839	TRP
1	C	802	HIS
1	B	726	ASN
1	C	808	THR

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 14 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	869	ASN
1	B	947	ASN
1	C	863	HIS
1	B	843	HIS
1	C	843	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](#)

Of 9 ligands modelled in this entry, 6 are monoatomic - leaving 3 for Mogul analysis.

In the following table, the Counts columns list the number of bonds (or angles) for which Mogul statistics could be retrieved, the number of bonds (or angles) that are observed in the model and the number of bonds (or angles) that are defined in the chemical component dictionary. The Link column lists molecule types, if any, to which the group is linked. 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 $|Z| > 2$ is considered an outlier worth inspection. RMSZ is the root-mean-square of all Z scores of the bond lengths (or angles).

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	$\# Z > 2$	Counts	RMSZ	$\# Z > 2$
2	9F4	A	2035	3	26,29,29	0.83	1 (3%)	32,41,41	1.00	1 (3%)
2	9F4	B	2034	3	26,29,29	0.78	0	32,41,41	1.04	1 (3%)
2	9F4	C	2035	3	26,29,29	0.81	1 (3%)	32,41,41	0.96	2 (6%)

In the following table, the Chirals column lists the number of chiral outliers, the number of chiral centers analysed, the number of these observed in the model and the number defined in the chemical

component dictionary. Similar counts are reported in the Torsion and Rings columns. '-' means no outliers of that kind were identified.

Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	9F4	A	2035	3	-	0/18/27/27	0/3/4/4
2	9F4	B	2034	3	-	0/18/27/27	0/3/4/4
2	9F4	C	2035	3	-	0/18/27/27	0/3/4/4

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	C	2035	9F4	C15-C16	-2.16	1.47	1.51
2	A	2035	9F4	C15-C16	-2.09	1.47	1.51

All (4) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	2034	9F4	O19-N18-C16	-4.20	113.92	119.86
2	A	2035	9F4	C6-C7-C8	-3.32	114.14	122.00
2	C	2035	9F4	O19-N18-C16	-2.63	116.15	119.86
2	C	2035	9F4	C6-C7-C8	-2.57	115.90	122.00

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, 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	349/395 (88%)	-0.37	1 (0%) 94 84	23, 36, 50, 62	0
1	B	352/395 (89%)	-0.50	0 100 100	24, 34, 46, 48	0
1	C	346/395 (87%)	-0.28	0 100 100	30, 43, 61, 70	0
All	All	1047/1185 (88%)	-0.38	1 (0%) 95 90	23, 38, 54, 70	0

All (1) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	726	ASN	2.3

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 carbohydrates 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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. The B-factors column lists the minimum, median, 95th 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	LLDF	B-factors(Å ²)	Q<0.9
2	9F4	A	2035	26/26	0.96	0.27	0.94	30,31,33,34	0

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Mol	Type	Chain	Res	Atoms	RSCC	RSR	LLDF	B-factors(\AA^2)	Q<0.9
2	9F4	B	2034	26/26	0.97	0.20	0.55	27,28,33,34	0
2	9F4	C	2035	26/26	0.95	0.23	0.53	33,35,38,38	0
3	ZN	C	2036	1/1	0.97	0.11	-1.39	33,33,33,33	0
3	ZN	B	2035	1/1	0.97	0.11	-2.46	25,25,25,25	0
3	ZN	A	2036	1/1	0.99	0.07	-3.32	28,28,28,28	0
3	ZN	C	2037	1/1	0.97	0.07	-	45,45,45,45	0
3	ZN	A	2037	1/1	0.98	0.07	-	40,40,40,40	0
3	ZN	B	2036	1/1	0.95	0.10	-	38,38,38,38	0

6.5 Other polymers [i](#)

There are no such residues in this entry.