



Full wwPDB X-ray Structure Validation Report ⓘ

Mar 10, 2026 – 01:56 PM UTC

PDB ID : 5YEH / pdb_00005yeh
Title : Crystal structure of CTCF ZFs4-8-eCBS
Authors : Yin, M.; Wang, J.; Wang, M.; Li, X.; Wang, Y.
Deposited on : 2017-09-17
Resolution : 2.33 Å(reported)

This is a Full wwPDB X-ray Structure Validation 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

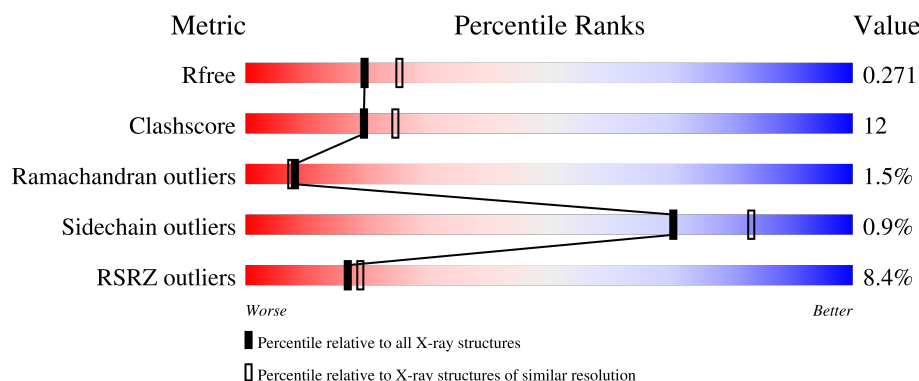
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.33 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	7754 (2.34-2.30)
Clashscore	190562	8383 (2.34-2.30)
Ramachandran outliers	187476	8303 (2.34-2.30)
Sidechain outliers	187428	8303 (2.34-2.30)
RSRZ outliers	180081	7760 (2.34-2.30)

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	142	
1	B	142	
2	C	20	
2	E	20	
3	D	20	

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Mol	Chain	Length	Quality of chain
3	F	20	 A horizontal bar chart showing the quality of chain F. The bar is divided into three segments: a small red segment at the beginning labeled '5%', a large green segment in the middle labeled '75%', and a yellow segment at the end labeled '25%'.

2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 3853 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 Transcriptional repressor CTCF.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	139	Total	C	N	O	S	0	0	0
			1072	663	209	186	14			
1	B	139	Total	C	N	O	S	0	0	0
			1076	666	210	186	14			

- Molecule 2 is a DNA chain called DNA (5'-D(*AP*CP*GP*GP*TP*TP*TP*CP*CP*GP*CP*TP*AP*GP*AP*GP*GP*GP*CP*G)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	C	20	Total	C	N	O	P	0	0	0
			409	195	78	117	19			
2	E	20	Total	C	N	O	P	0	0	0
			409	195	78	117	19			

- Molecule 3 is a DNA chain called DNA (5'-D(*TP*CP*GP*CP*CP*CP*TP*CP*TP*AP*GP*CP*GP*GP*AP*AP*AP*CP*CP*G)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	D	20	Total	C	N	O	P	0	0	0
			403	192	75	117	19			
3	F	20	Total	C	N	O	P	0	0	0
			403	192	75	117	19			

- Molecule 4 is ZINC ION (CCD ID: ZN) (formula: Zn).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	5	Total	Zn	0	0
			5	5		
4	B	5	Total	Zn	0	0
			5	5		

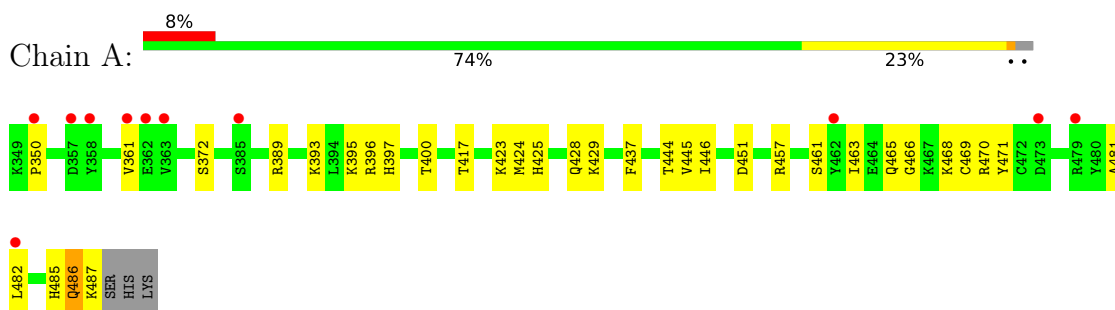
- Molecule 5 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	26	Total 26	O 26	0	0
5	C	5	Total 5	O 5	0	0
5	D	5	Total 5	O 5	0	0
5	B	10	Total 10	O 10	0	0
5	E	15	Total 15	O 15	0	0
5	F	10	Total 10	O 10	0	0

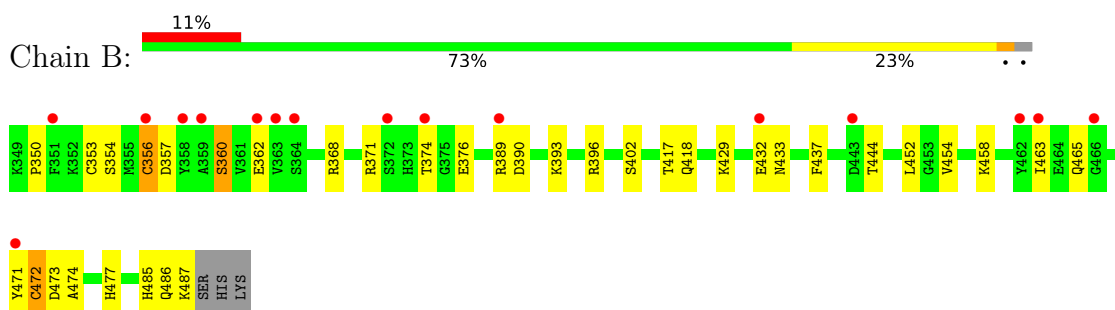
3 Residue-property plots

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 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.

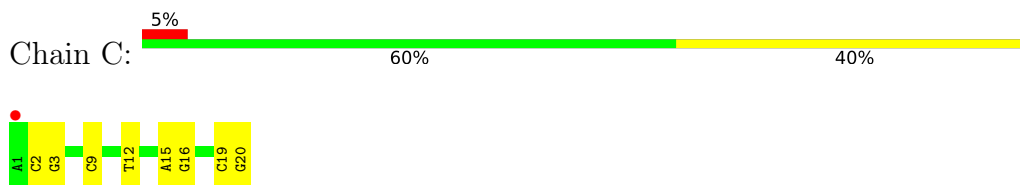
• Molecule 1: Transcriptional repressor CTCF



• Molecule 1: Transcriptional repressor CTCF



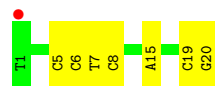
• Molecule 2: DNA (5'-D(*AP*CP*GP*GP*TP*TP*TP*CP*CP*GP*CP*TP*AP*GP*AP*GP*GP*GP*CP*G)-3')



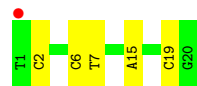
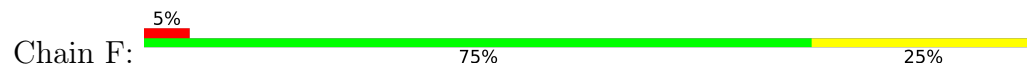
• Molecule 2: DNA (5'-D(*AP*CP*GP*GP*TP*TP*TP*CP*CP*GP*CP*TP*AP*GP*AP*GP*GP*GP*CP*G)-3')



- Molecule 3: DNA (5'-D(*TP*CP*GP*CP*CP*CP*TP*CP*TP*AP*GP*CP*GP*GP*AP*AP*AP*CP*CP*G)-3')



- Molecule 3: DNA (5'-D(*TP*CP*GP*CP*CP*CP*TP*CP*TP*AP*GP*CP*GP*GP*AP*AP*AP*CP*CP*G)-3')



4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, α , β , γ	45.84Å 54.88Å 66.94Å 81.17° 80.11° 79.72°	Depositor
Resolution (Å)	32.71 – 2.33 32.71 – 2.33	Depositor EDS
% Data completeness (in resolution range)	95.8 (32.71-2.33) 95.7 (32.71-2.33)	Depositor EDS
R_{merge}	0.07	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.70 (at 2.34Å)	Xtriage
Refinement program	PHENIX (1.12_2829: ???)	Depositor
R, R_{free}	0.222 , 0.270 0.223 , 0.271	Depositor DCC
R_{free} test set	1294 reflections (4.81%)	wwPDB-VP
Wilson B-factor (Å ²)	45.6	Xtriage
Anisotropy	0.391	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.29 , 51.2	EDS
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.34$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	3853	wwPDB-VP
Average B, all atoms (Å ²)	63.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 10.08% 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

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: 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	0.45	0/1099	0.73	0/1480
1	B	0.46	0/1103	0.78	1/1484 (0.1%)
2	C	0.46	0/459	0.62	0/705
2	E	0.44	0/459	0.64	0/705
3	D	0.45	0/451	0.63	0/693
3	F	0.43	0/451	0.64	0/693
All	All	0.45	0/4022	0.70	1/5760 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	472	CYS	N-CA-C	5.15	116.23	108.46

There are no chirality outliers.

There are no planarity outliers.

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	1072	0	977	33	0
1	B	1076	0	989	30	0
2	C	409	0	226	7	0
2	E	409	0	226	9	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
3	D	403	0	225	5	0
3	F	403	0	225	8	0
4	A	5	0	0	0	0
4	B	5	0	0	0	0
5	A	26	0	0	4	0
5	B	10	0	0	3	0
5	C	5	0	0	0	0
5	D	5	0	0	1	0
5	E	15	0	0	1	0
5	F	10	0	0	3	0
All	All	3853	0	2868	77	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 12.

All (77) 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:356:CYS:SG	5:B:606:HOH:O	2.29	0.91
3:F:15:DA:OP1	5:F:101:HOH:O	1.89	0.90
1:B:432:GLU:OE1	5:B:601:HOH:O	1.94	0.86
1:A:451:ASP:OD2	5:A:601:HOH:O	1.95	0.82
1:B:418:GLN:HE22	2:E:13:DA:H62	1.24	0.82
1:B:362:GLU:OE2	3:F:2:DC:C5	2.32	0.82
1:A:395:LYS:NZ	3:D:5:DC:OP2	2.11	0.82
1:B:389:ARG:NH2	1:B:390:ASP:OD2	2.15	0.80
2:E:2:DC:OP2	5:E:101:HOH:O	2.00	0.79
1:A:400:THR:HG22	2:C:12:DT:OP1	1.84	0.76
3:F:6:DC:OP1	5:F:102:HOH:O	2.03	0.76
3:F:19:DC:OP2	5:F:103:HOH:O	2.04	0.75
3:D:19:DC:H2''	3:D:20:DG:C8	2.24	0.73
1:B:417:THR:HG21	2:E:12:DT:OP2	1.88	0.71
1:A:469:CYS:SG	1:A:471:TYR:HD1	2.13	0.71
1:A:457:ARG:O	1:A:461:SER:OG	2.09	0.71
1:A:417:THR:HG21	2:C:12:DT:OP2	1.92	0.68
1:A:350:PRO:HD2	1:A:361:VAL:HA	1.75	0.67
1:A:445:VAL:C	1:A:446:ILE:HD12	2.20	0.67
1:B:393:LYS:NZ	2:E:15:DA:N7	2.41	0.67
1:A:393:LYS:NZ	2:C:15:DA:N7	2.42	0.66
1:A:444:THR:HG22	1:A:446:ILE:CD1	2.26	0.65
1:A:396:ARG:O	5:A:602:HOH:O	2.14	0.64

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:469:CYS:SG	1:A:471:TYR:CD1	2.90	0.64
1:B:371:ARG:HA	1:B:374:THR:HG22	1.79	0.63
1:B:362:GLU:OE2	3:F:2:DC:H5	1.82	0.63
1:B:472:CYS:O	1:B:474:ALA:N	2.31	0.63
1:A:470:ARG:H	1:A:486:GLN:NE2	1.96	0.63
1:A:468:LYS:NZ	1:A:469:CYS:O	2.30	0.63
1:B:356:CYS:SG	1:B:357:ASP:N	2.71	0.62
1:B:362:GLU:CD	3:F:2:DC:C5	2.78	0.62
2:C:2:DC:H2''	2:C:3:DG:C8	2.37	0.60
1:A:485:HIS:C	1:A:487:LYS:H	2.10	0.59
1:A:482:LEU:O	1:A:486:GLN:HG3	2.03	0.59
1:B:485:HIS:C	1:B:487:LYS:H	2.12	0.58
1:A:470:ARG:H	1:A:486:GLN:HE21	1.51	0.57
1:A:444:THR:HG22	1:A:446:ILE:HD11	1.87	0.55
1:B:396:ARG:O	5:B:602:HOH:O	2.18	0.55
2:E:19:DC:H2''	2:E:20:DG:N7	2.21	0.55
1:B:417:THR:HG22	1:B:418:GLN:HG3	1.87	0.55
1:B:463:ILE:O	1:B:477:HIS:ND1	2.40	0.55
1:B:485:HIS:O	1:B:487:LYS:N	2.41	0.53
2:E:2:DC:H2''	2:E:3:DG:C8	2.43	0.53
1:B:362:GLU:CD	3:F:2:DC:H5	2.13	0.52
2:C:15:DA:H2'	2:C:16:DG:C8	2.44	0.52
1:B:350:PRO:HD2	1:B:360:SER:O	2.09	0.52
1:B:374:THR:HG23	1:B:376:GLU:H	1.75	0.51
1:A:372:SER:OG	1:A:389:ARG:NH2	2.43	0.50
2:E:1:DA:H2''	2:E:2:DC:C6	2.47	0.50
1:A:466:GLY:N	5:A:604:HOH:O	2.26	0.49
1:B:353:CYS:SG	1:B:354:SER:N	2.85	0.48
1:B:454:VAL:O	1:B:458:LYS:HG3	2.13	0.48
3:D:15:DA:H8	5:D:101:HOH:O	1.97	0.48
1:B:429:LYS:NZ	2:E:9:DC:OP1	2.44	0.47
3:F:6:DC:H2''	3:F:7:DT:O5'	2.14	0.47
1:A:481:ALA:O	5:A:603:HOH:O	2.20	0.47
1:A:444:THR:CG2	1:A:446:ILE:HD11	2.44	0.46
2:E:11:DC:H2''	2:E:12:DT:H5'	1.98	0.46
1:A:424:MET:HE3	1:A:428:GLN:HE21	1.81	0.45
1:B:368:ARG:HD2	1:B:389:ARG:NH2	2.31	0.45
1:A:429:LYS:NZ	2:C:9:DC:P	2.89	0.45
1:A:437:PHE:CE2	1:B:402:SER:HB2	2.52	0.44
1:B:432:GLU:O	1:B:433:ASN:HB2	2.17	0.44
2:C:19:DC:H2''	2:C:20:DG:N7	2.32	0.44

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
3:D:6:DC:H2'	3:D:7:DT:C6	2.53	0.43
1:A:397:HIS:O	1:A:400:THR:OG1	2.33	0.43
1:A:485:HIS:C	1:A:487:LYS:N	2.76	0.43
1:A:485:HIS:O	1:A:487:LYS:N	2.51	0.43
1:B:437:PHE:HB3	1:B:452:LEU:HD22	2.01	0.42
1:B:471:TYR:O	1:B:472:CYS:HB3	2.20	0.42
1:A:424:MET:CE	1:A:428:GLN:HE21	2.33	0.41
1:B:463:ILE:C	1:B:465:GLN:H	2.29	0.41
1:A:425:HIS:O	1:A:429:LYS:HB2	2.21	0.41
1:A:423:LYS:NZ	3:D:8:DC:OP2	2.48	0.41
1:A:446:ILE:HD12	1:A:446:ILE:N	2.35	0.41
1:B:485:HIS:C	1:B:485:HIS:CD2	2.98	0.41
1:A:463:ILE:HG22	1:A:465:GLN:H	1.86	0.40

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	137/142 (96%)	135 (98%)	1 (1%)	1 (1%)	18	22
1	B	137/142 (96%)	127 (93%)	7 (5%)	3 (2%)	5	4
All	All	274/284 (96%)	262 (96%)	8 (3%)	4 (2%)	8	7

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	486	GLN
1	B	473	ASP
1	B	486	GLN
1	B	444	THR

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	108/130 (83%)	108 (100%)	0	100	100
1	B	109/130 (84%)	107 (98%)	2 (2%)	51	69
All	All	217/260 (84%)	215 (99%)	2 (1%)	70	83

All (2) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	356	CYS
1	B	360	SER

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	425	HIS
1	A	428	GLN
1	A	486	GLN
1	B	418	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

Of 10 ligands modelled in this entry, 10 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

There are no such residues in this entry.

5.8 Polymer linkage issues

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, 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	139/142 (97%)	0.83	11 (7%) 18 21	29, 58, 91, 106	0
1	B	139/142 (97%)	0.88	16 (11%) 9 11	26, 54, 105, 112	0
2	C	20/20 (100%)	0.38	1 (5%) 34 36	36, 58, 114, 140	0
2	E	20/20 (100%)	0.36	0 100 100	34, 66, 123, 142	0
3	D	20/20 (100%)	0.30	1 (5%) 34 36	45, 55, 113, 135	0
3	F	20/20 (100%)	0.44	1 (5%) 34 36	50, 59, 109, 129	0
All	All	358/364 (98%)	0.75	30 (8%) 17 19	26, 57, 105, 142	0

All (30) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	362	GLU	5.2
1	B	362	GLU	5.0
1	B	351	PHE	4.3
3	D	1	DT	3.8
1	A	363	VAL	3.7
1	A	361	VAL	3.3
1	A	462	TYR	3.3
1	B	462	TYR	3.1
1	B	463	ILE	3.0
1	B	372	SER	3.0
1	B	358	TYR	3.0
1	B	471	TYR	2.7
1	B	359	ALA	2.6
1	A	482	LEU	2.6
1	A	385	SER	2.6
1	B	443	ASP	2.5
1	B	374	THR	2.4
3	F	1	DT	2.4
2	C	1	DA	2.4

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Mol	Chain	Res	Type	RSRZ
1	B	364	SER	2.3
1	A	350	PRO	2.3
1	A	357	ASP	2.2
1	A	473	ASP	2.1
1	B	389	ARG	2.1
1	B	432	GLU	2.1
1	A	358	TYR	2.1
1	B	466	GLY	2.1
1	A	479	ARG	2.0
1	B	363	VAL	2.0
1	B	356	CYS	2.0

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](#)

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, 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	B-factors(Å ²)	Q<0.9
4	ZN	B	501	1/1	0.93	0.07	88,88,88,88	0
4	ZN	A	505	1/1	0.97	0.06	86,86,86,86	0
4	ZN	A	501	1/1	0.98	0.05	97,97,97,97	0
4	ZN	B	505	1/1	0.98	0.09	92,92,92,92	0
4	ZN	A	502	1/1	0.99	0.03	46,46,46,46	0
4	ZN	A	503	1/1	0.99	0.03	42,42,42,42	0
4	ZN	B	502	1/1	0.99	0.02	43,43,43,43	0
4	ZN	B	503	1/1	0.99	0.04	41,41,41,41	0
4	ZN	A	504	1/1	0.99	0.02	38,38,38,38	0
4	ZN	B	504	1/1	1.00	0.06	45,45,45,45	0

6.5 Other polymers [i](#)

There are no such residues in this entry.