



Full wwPDB X-ray Structure Validation Report

Feb 26, 2014 – 10:16 PM GMT

PDB ID : 3FPZ
Title : Saccharomyces cerevisiae THI4p is a suicide thiamin thiazole synthase
Authors : Bale, S.; Chatterjee, A.; Dorrestein, P.C.; Begley, T.P.; Ealick, S.E.
Deposited on : 2009-01-06
Resolution : 1.82 Å(reported)

This is a full wwPDB validation 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/ValidationPDFNotes.html>

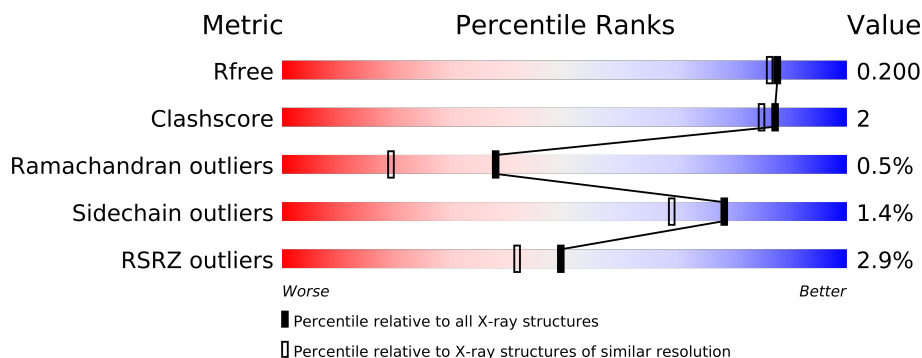
The following versions of software and data (see [references](#)) were used in the production of this report:

MolProbity : 4.02b-467
Mogul : 1.15 2013
Xtriage (Phenix) : dev-1323
EDS : stable22639
Percentile statistics : 21963
Refmac : 5.8.0049
CCP4 : 6.3.0 (Settle)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et. al. (1996)
Validation Pipeline (wwPDB-VP) : stable22683

1 Overall quality at a glance

The reported resolution of this entry is 1.82 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}	66092	4101 (1.84-1.80)
Clashscore	79885	5140 (1.84-1.80)
Ramachandran outliers	78287	5077 (1.84-1.80)
Sidechain outliers	78261	5077 (1.84-1.80)
RSRZ outliers	66119	4103 (1.84-1.80)

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. The upper red bar (where present) indicates the fraction of residues that have poor fit to the electron density.

Mol	Chain	Length	Quality of chain
1	A	326	
1	B	326	

The following table lists non-polymeric compounds that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Geometry	Electron density
3	SO4	A	328	-	X

2 Entry composition i

There are 4 unique types of molecules in this entry. The entry contains 5237 atoms, of which 0 are hydrogen and 0 are deuterium.

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.

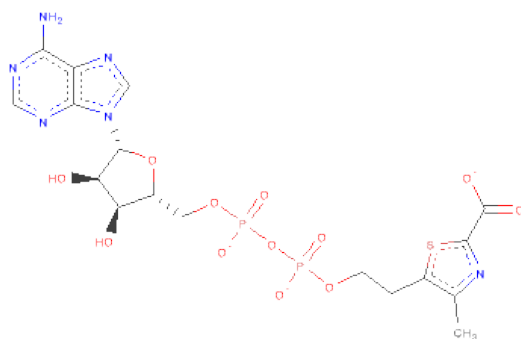
- Molecule 1 is a protein called Thiazole biosynthetic enzyme.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	311	Total	C	N	O	S	0	2	0
			2342	1486	398	442	16			
1	B	307	Total	C	N	O	S	0	2	0
			2313	1468	393	436	16			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	205	DHA	CYS	SEE REMARK 999	UNP P32318
B	205	DHA	CYS	SEE REMARK 999	UNP P32318

- Molecule 2 is ADENOSINE DIPHOSPHATE 5-(BETA-ETHYL)-4-METHYL-THIAZOLE-2-CARBOXYLICACID (three-letter code: AHZ) (formula: C₁₇H₁₉N₆O₁₂P₂S).



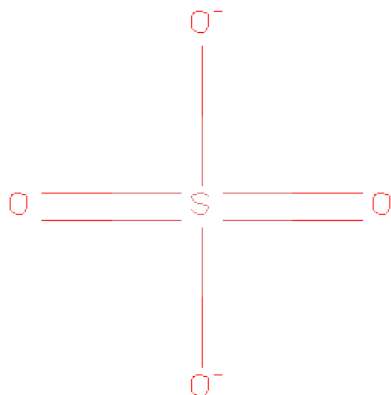
Mol	Chain	Residues	Atoms						ZeroOcc	AltConf
2	A	1	Total	C	N	O	P	S	0	0
			38	17	6	12	2	1		

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Mol	Chain	Residues	Atoms						ZeroOcc	AltConf
2	B	1	Total	C	N	O	P	S	0	0
			38	17	6	12	2	1		

- Molecule 3 is SULFATE ION (three-letter code: SO4) (formula: O₄S).



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

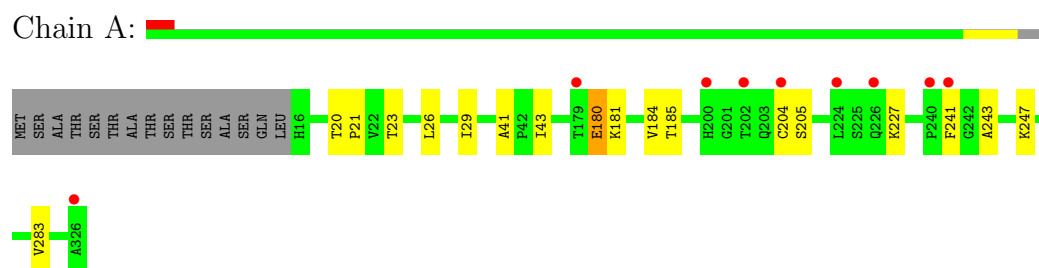
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	241	Total	O	0	0
			241	241		
4	B	250	Total	O	0	0
			250	250		

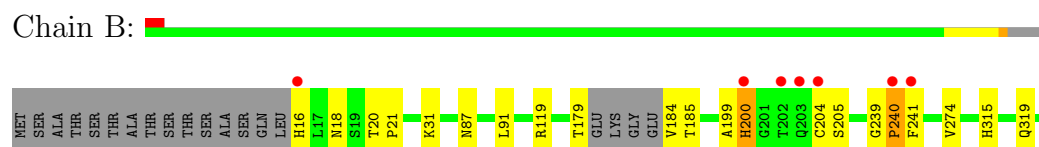
3 Residue-property plots

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: Thiazole biosynthetic enzyme



- Molecule 1: Thiazole biosynthetic enzyme



4 Data and refinement statistics

Property	Value	Source
Space group	I 4	Depositor
Cell constants a, b, c, α , β , γ	140.70 Å 140.70 Å 73.33 Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	49.75 – 1.82 49.74 – 1.82	Depositor EDS
% Data completeness (in resolution range)	98.8 (49.75-1.82) 98.7 (49.74-1.82)	Depositor EDS
R_{merge}	0.04	Depositor
R_{sym}	0.04	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.91 (at 1.82 Å)	Xtriage
Refinement program	REFMAC 5.4.0066	Depositor
R, R_{free}	0.195 , 0.236 0.184 , 0.200	Depositor DCC
R_{free} test set	3212 reflections (5.34%)	DCC
Wilson B-factor (Å ²)	24.2	Xtriage
Anisotropy	0.295	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 46.5	EDS
Estimated twinning fraction	0.479 for -k,-h,-l	Xtriage
L-test for twinning	$\langle L \rangle = 0.51$, $\langle L^2 \rangle = 0.34$	Xtriage
Outliers	0 of 63282 reflections	Xtriage
F_o, F_c correlation	0.96	EDS
Total number of atoms	5237	wwPDB-VP
Average B, all atoms (Å ²)	28.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.01% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

5 Model quality

5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: AHZ, SO4, DHA

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	0.63	0/2387	0.62	0/3236
1	B	0.65	0/2357	0.63	0/3193
All	All	0.64	0/4744	0.62	0/6429

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
1	B	0	1
All	All	0	2

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	205	DHA	Peptide
1	B	205	DHA	Peptide

5.2 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 hydrogens added by MolProbity. The Clashes column lists the number of clashes within the asymmetric unit, and the number in parentheses is this value normalized per 1000 atoms of the molecule in the

chain. The Symm-Clashes column gives symmetry related clashes, in the same way as for the Clashes column.

Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
1	A	2342	0	2301	12	0
1	B	2313	0	2272	14	0
2	A	38	0	19	1	0
2	B	38	0	19	1	0
3	A	10	0	0	0	0
3	B	5	0	0	0	0
4	A	241	0	0	2	0
4	B	250	0	0	0	0
All	All	5237	0	4611	23	0

Clashscore is defined as the number of clashes calculated for the entry per 1000 atoms (including hydrogens) of the entry. The overall clashscore for this entry is 2.

All (23) close contacts within the same asymmetric unit are listed below.

Atom-1	Atom-2	Distance(Å)	Clash(Å)
1:B:199:ALA:HA	1:B:200:HIS:CB	1.90	1.02
1:A:180:GLU:N	1:A:181:LYS:HA	1.85	0.88
1:B:199:ALA:CA	1:B:200:HIS:CB	2.66	0.72
1:B:20:THR:HB	1:B:21:PRO:HD2	1.76	0.67
1:A:180:GLU:H	1:A:181:LYS:HA	1.57	0.67
1:A:26:LEU:HD22	1:A:29:ILE:HD11	1.74	0.67
1:B:16:HIS:HA	1:B:18:ASN:OD1	1.96	0.65
4:A:390:HOH:O	1:B:315:HIS:HE1	1.84	0.60
1:B:241:PHE:HB3	2:B:1101:AHZ:N7	2.18	0.58
1:B:20:THR:HB	1:B:21:PRO:CD	2.38	0.54
1:A:184:VAL:HB	1:A:283:VAL:HG22	1.93	0.51
1:A:23:THR:H	1:B:87:ASN:HD21	1.58	0.51
1:B:184:VAL:CB	1:B:185:THR:HA	2.41	0.51
1:B:274:VAL:O	1:B:315:HIS:HD2	1.95	0.50
1:A:185:THR:HA	4:A:693:HOH:O	2.11	0.50
1:A:43:ILE:HB	1:B:119:ARG:HD3	1.94	0.48
1:A:180:GLU:H	1:A:181:LYS:CA	2.24	0.48
1:B:315:HIS:CE1	1:B:319:GLN:HE21	2.32	0.47
1:A:241:PHE:HB2	2:A:1100:AHZ:N7	2.29	0.47
1:A:243:ALA:HB3	1:A:247:LYS:HE3	1.97	0.46
1:A:41:ALA:O	1:B:119:ARG:HD2	2.19	0.42
1:B:239:GLY:HA3	1:B:240:PRO:HD3	1.83	0.41
1:A:20:THR:HB	1:A:21:PRO:HD2	2.02	0.41

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	310/326 (95%)	297 (96%)	12 (4%)	1 (0%)	50	31
1	B	304/326 (93%)	293 (96%)	9 (3%)	2 (1%)	30	13
All	All	614/652 (94%)	590 (96%)	21 (3%)	3 (0%)	38	19

All (3) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	200	HIS
1	B	240	PRO
1	A	180	GLU

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	248/265 (94%)	245 (99%)	3 (1%)	82	74
1	B	245/265 (92%)	241 (98%)	4 (2%)	75	63
All	All	493/530 (93%)	486 (99%)	7 (1%)	78	69

All (7) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	204	CYS
1	A	227	LYS
1	A	255	ASN
1	B	31	LYS
1	B	91	LEU
1	B	179	THR

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Mol	Chain	Res	Type
1	B	204	CYS

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

Mol	Chain	Res	Type
1	B	87	ASN
1	B	203	GLN
1	B	285	ASN
1	B	315	HIS

5.3.3 RNA ⓘ

There are no RNA chains in this entry.

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

2 non-standard protein/DNA/RNA residues are modelled in this entry.

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	$\# Z > 2$
1	DHA	A	205	1	3,4,5	1.53	0	1,4,6	4.28	1 (100%)
1	DHA	B	205	1	3,4,5	1.54	0	1,4,6	3.78	1 (100%)

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
1	DHA	A	205	1	-	0/0/2/4	0/0/0/0
1	DHA	B	205	1	-	0/0/2/4	0/0/0/0

There are no bond length outliers.

All (2) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	205	DHA	CB-CA-N	-4.28	116.82	126.32
1	B	205	DHA	CB-CA-N	-3.78	117.94	126.32

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

5.5 Carbohydrates i

There are no carbohydrates in this entry.

5.6 Ligand geometry i

5 ligands are modelled in this entry.

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	AHZ	A	1100	-	38,41,41	1.25	3 (7%)	57,62,62	2.00	15 (26%)
3	SO4	A	327	-	4,4,4	0.21	0	6,6,6	0.09	0
3	SO4	A	328	-	4,4,4	0.17	0	6,6,6	0.07	0
2	AHZ	B	1101	-	38,41,41	1.27	3 (7%)	57,62,62	1.96	16 (28%)
3	SO4	B	327	-	4,4,4	0.15	0	6,6,6	0.12	0

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	AHZ	A	1100	-	-	0/23/43/43	0/2/4/4

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
3	SO4	A	327	-	-	0/0/0/0	0/0/0/0
3	SO4	A	328	-	-	0/0/0/0	0/0/0/0
2	AHZ	B	1101	-	-	0/23/43/43	0/2/4/4
3	SO4	B	327	-	-	0/0/0/0	0/0/0/0

All (6) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	B	1101	AHZ	O4'-C1'	4.14	1.47	1.41
2	A	1100	AHZ	O4'-C1'	3.44	1.46	1.41
2	A	1100	AHZ	PA-O3A	2.81	1.66	1.60
2	B	1101	AHZ	C2T-S1T	-2.71	1.69	1.73
2	A	1100	AHZ	C2T-S1T	-2.55	1.70	1.73
2	B	1101	AHZ	PA-O3A	2.07	1.64	1.60

All (31) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	1100	AHZ	N3-C2-N1	-7.27	122.63	128.71
2	B	1101	AHZ	N3-C2-N1	-7.16	122.72	128.71
2	A	1100	AHZ	O4'-C1'-N9	-5.49	103.33	108.44
2	B	1101	AHZ	O4'-C1'-N9	-4.91	103.87	108.44
2	B	1101	AHZ	N3-C4-N9	4.69	133.90	125.43
2	A	1100	AHZ	N3-C4-N9	4.64	133.81	125.43
2	A	1100	AHZ	O4'-C1'-C2'	-4.00	100.64	106.77
2	B	1101	AHZ	O4'-C1'-C2'	-3.63	101.20	106.77
2	A	1100	AHZ	C4T-C5T-S1T	-3.33	107.17	110.69
2	B	1101	AHZ	C5-C4-N3	-3.17	118.80	125.70
2	B	1101	AHZ	C4T-C5T-S1T	-3.12	107.39	110.69
2	A	1100	AHZ	C5-C4-N3	-2.98	119.21	125.70
2	B	1101	AHZ	C2T-N3T-C4T	2.90	114.17	107.16
2	A	1100	AHZ	C2T-N3T-C4T	2.85	114.04	107.16
2	B	1101	AHZ	C4'-O4'-C1'	-2.69	106.82	109.75
2	B	1101	AHZ	C4-C5-N7	-2.67	107.24	109.52
2	A	1100	AHZ	C6T-C5T-C4T	2.56	129.30	127.44
2	B	1101	AHZ	S1T-C2T-N3T	-2.46	110.28	117.14
2	A	1100	AHZ	C5T-C4T-N3T	2.41	114.97	111.52
2	A	1100	AHZ	S1T-C2T-N3T	-2.40	110.45	117.14
2	A	1100	AHZ	C4-C5-N7	-2.39	107.47	109.52
2	B	1101	AHZ	C5T-C4T-N3T	2.28	114.79	111.52
2	A	1100	AHZ	C2'-C1'-N9	2.25	119.03	113.27
2	B	1101	AHZ	C6T-C5T-C4T	2.24	129.07	127.44

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	B	1101	AHZ	O2B-PB-O3A	-2.20	102.84	108.79
2	A	1100	AHZ	C4'-O4'-C1'	-2.17	107.39	109.75
2	B	1101	AHZ	C7T-C6T-C5T	-2.17	106.66	112.48
2	A	1100	AHZ	C6T-C5T-S1T	2.09	123.52	120.74
2	B	1101	AHZ	C6T-C5T-S1T	2.09	123.52	120.74
2	A	1100	AHZ	O2B-PB-O3A	-2.07	103.19	108.79
2	B	1101	AHZ	C2-N3-C4	2.05	119.85	114.01

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

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	311/326 (95%)	0.05	11 (3%) 42 34	14, 24, 47, 56	0
1	B	307/326 (94%)	-0.01	7 (2%) 57 51	14, 24, 45, 59	0
All	All	618/652 (94%)	0.02	18 (2%) 49 41	14, 24, 47, 59	0

All (18) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	241	PHE	5.7
1	A	241	PHE	5.2
1	A	202	THR	4.7
1	B	202	THR	4.3
1	B	240	PRO	4.0
1	A	326	ALA	3.9
1	A	240	PRO	3.4
1	A	252	ILE	3.1
1	B	200	HIS	3.0
1	A	179	THR	2.8
1	A	226	GLN	2.8
1	A	200	HIS	2.6
1	A	224	LEU	2.3
1	B	16	HIS	2.2
1	A	256	GLN	2.2
1	B	204	CYS	2.2
1	B	203	GLN	2.1
1	A	204	CYS	2.1

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

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	RSR	LLDF	B-factors(Å ²)	Q<0.9
1	DHA	A	205	5/6	0.30	2.69	38,38,40,41	0
1	DHA	B	205	5/6	0.28	2.23	37,37,39,41	0

6.3 Carbohydrates ⓘ

There are no carbohydrates in this entry.

6.4 Ligands ⓘ

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	RSR	LLDF	B-factors(Å ²)	Q<0.9
3	SO4	A	328	5/5	0.21	3.41	89,89,89,89	0
3	SO4	B	327	5/5	0.12	0.29	70,71,71,71	0
2	AHZ	A	1100	38/38	0.12	0.07	19,23,44,44	0
2	AHZ	B	1101	38/38	0.10	-0.08	19,22,41,42	0
3	SO4	A	327	5/5	0.09	-1.20	73,73,74,74	0

6.5 Other polymers ⓘ

There are no such residues in this entry.