



wwPDB X-ray Structure Validation Summary Report ⓘ

Jan 31, 2016 – 09:45 PM GMT

PDB ID : 1QF6
Title : STRUCTURE OF E. COLI THREONYL-TRNA SYNTHETASE COM-
PLEXED WITH ITS COGNATE TRNA
Authors : Sankaranarayanan, R.; Dock-Bregeon, A.C.; Rees, B.; Moras, D.
Deposited on : 1999-04-06
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
<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

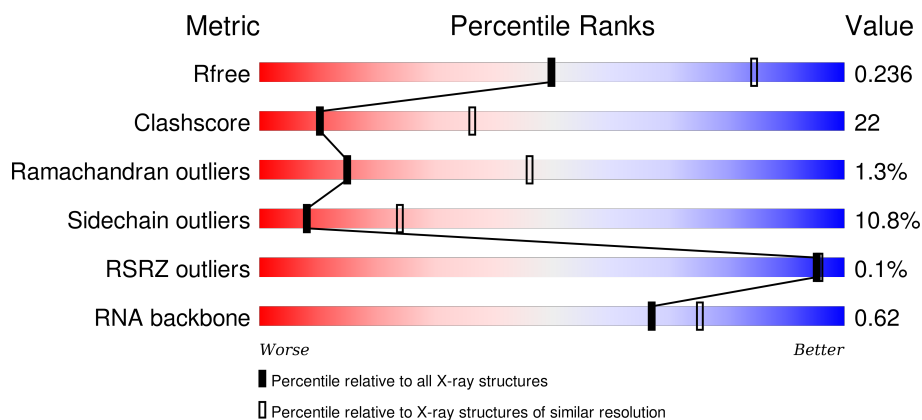
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 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}	91344	1451 (2.90-2.90)
Clashscore	102246	1668 (2.90-2.90)
Ramachandran outliers	100387	1630 (2.90-2.90)
Sidechain outliers	100360	1632 (2.90-2.90)
RSRZ outliers	91569	1456 (2.90-2.90)
RNA backbone	2183	1093 (3.30-2.50)

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	B	76	
2	A	642	

2 Entry composition [i](#)

There are 5 unique types of molecules in this entry. The entry contains 7093 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 RNA chain called THREONINE TRNA.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	B	76	Total	C	N	O	P	0	0	0
			1633	731	288	538	76			

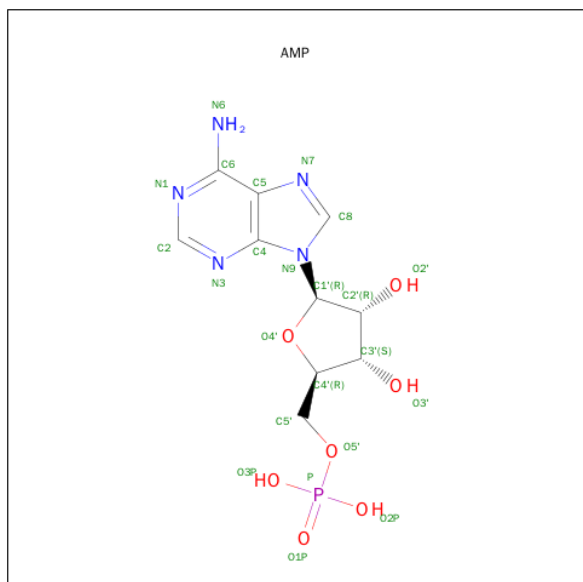
- Molecule 2 is a protein called THREONYL-TRNA SYNTHETASE.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	A	641	Total	C	N	O	S	0	0	0
			5192	3274	915	968	35			

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

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	1	Total	Zn	0	0
			1	1		

- Molecule 4 is ADENOSINE MONOPHOSPHATE (three-letter code: AMP) (formula: C₁₀H₁₄N₅O₇P).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
4	A	1	Total	C	N	O	P	0	0
			23	10	5	7	1		

- Molecule 5 is water.

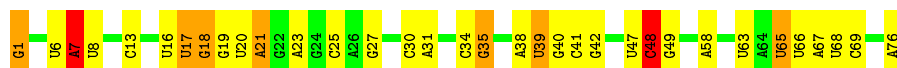
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	A	164	Total	O	0	0
			164	164		
5	B	80	Total	O	0	0
			80	80		

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.

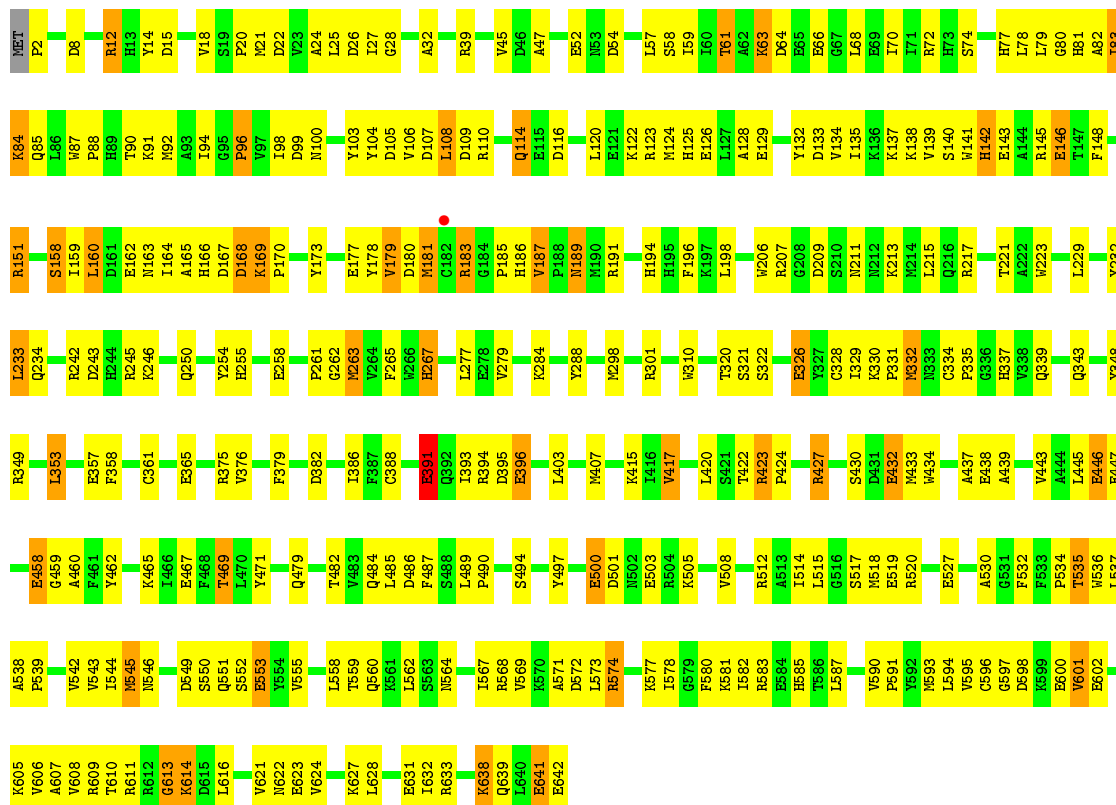
• Molecule 1: THREONINE TRNA

Chain B: 



• Molecule 2: THREONYL-TRNA SYNTHETASE

Chain A: 



4 Data and refinement statistics

Property	Value	Source
Space group	P 31 2 1	Depositor
Cell constants a, b, c, α , β , γ	162.67Å 162.67Å 128.57Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	20.00 – 2.90 29.90 – 2.70	Depositor EDS
% Data completeness (in resolution range)	94.0 (20.00-2.90) 91.8 (29.90-2.70)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.07	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.74 (at 2.72Å)	Xtriage
Refinement program	CNS 0.5	Depositor
R, R_{free}	0.195 , 0.239 0.197 , 0.236	Depositor DCC
R_{free} test set	3118 reflections (7.59%)	DCC
Wilson B-factor (Å ²)	56.3	Xtriage
Anisotropy	0.091	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.32 , 49.2	EDS
Estimated twinning fraction	0.020 for -h,-k,l	Xtriage
L-test for twinning ²	$\langle L \rangle = 0.50$, $\langle L^2 \rangle = 0.33$	Xtriage
Outliers	0 of 53157 reflections	Xtriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	7093	wwPDB-VP
Average B, all atoms (Å ²)	52.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.53% 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, 0.375 respectively for untwinned datasets, and 0.333, 0.2 for perfectly twinned datasets.

5 Model quality [i](#)

5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: 5MU, ZN, AET, G7M, H2U, AMP, PSU

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	B	0.72	1/1649 (0.1%)	0.81	3/2567 (0.1%)
2	A	0.68	9/5308 (0.2%)	0.80	4/7158 (0.1%)
All	All	0.69	10/6957 (0.1%)	0.81	7/9725 (0.1%)

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	B	2	8

The worst 5 of 10 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	146	GLU	CG-CD	8.38	1.64	1.51
2	A	146	GLU	CD-OE2	8.08	1.34	1.25
2	A	391	GLU	CD-OE1	7.33	1.33	1.25
1	B	1	G	OP3-P	-6.81	1.52	1.61
2	A	146	GLU	CD-OE1	6.53	1.32	1.25

The worst 5 of 7 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	7	A	C2'-C3'-O3'	10.06	131.62	109.50
1	B	48	C	C2'-C3'-O3'	9.36	130.10	109.50
2	A	358	PHE	N-CA-C	-5.95	94.93	111.00
2	A	613	GLY	N-CA-C	-5.47	99.42	113.10
1	B	21	A	N9-C1'-C2'	5.40	121.02	114.00

All (2) chirality outliers are listed below:

Mol	Chain	Res	Type	Atom
1	B	7	A	C3'
1	B	48	C	C3'

5 of 8 planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	B	1	G	Sidechain
1	B	19	G	Sidechain
1	B	21	A	Sidechain
1	B	25	C	Sidechain
1	B	27	G	Sidechain

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	B	1633	0	835	16	0
2	A	5192	0	5073	258	0
3	A	1	0	0	0	0
4	A	23	0	12	2	0
5	A	164	0	0	4	0
5	B	80	0	0	0	0
All	All	7093	0	5920	273	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 22.

The worst 5 of 273 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)
2:A:143:GLU:HB3	5:A:1144:HOH:O	1.64	0.98
2:A:125:HIS:O	2:A:129:GLU:HG2	1.69	0.92
2:A:158:SER:O	2:A:162:GLU:HG2	1.72	0.88
2:A:21:MET:O	2:A:25:LEU:HD12	1.74	0.88
2:A:145:ARG:HH11	2:A:145:ARG:HG2	1.39	0.88

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	
2	A	639/642 (100%)	561 (88%)	70 (11%)	8 (1%)	15	46

5 of 8 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
2	A	183	ARG
2	A	601	VAL
2	A	614	LYS
2	A	605	LYS
2	A	26	ASP

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	
2	A	557/558 (100%)	497 (89%)	60 (11%)	8	24

5 of 60 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	A	189	ASN
2	A	332	MET
2	A	553	GLU
2	A	267	HIS

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Mol	Chain	Res	Type
2	A	353	LEU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 19 such sidechains are listed below:

Mol	Chain	Res	Type
2	A	267	HIS
2	A	342	ASN
2	A	560	GLN
2	A	257	GLN
2	A	564	ASN

5.3.3 RNA [i](#)

Mol	Chain	Analysed	Backbone Outliers	Pucker Outliers
1	B	75/76 (98%)	13 (17%)	3 (4%)

5 of 13 RNA backbone outliers are listed below:

Mol	Chain	Res	Type
1	B	8	U
1	B	13	C
1	B	16	H2U
1	B	17	H2U
1	B	18	G

All (3) RNA pucker outliers are listed below:

Mol	Chain	Res	Type
1	B	7	A
1	B	38	A
1	B	48	C

5.4 Non-standard residues in protein, DNA, RNA chains [i](#)

7 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	H2U	B	16	1	17,21,22	1.04	1 (5%)	23,30,33	1.06	2 (8%)
1	H2U	B	17	1	17,21,22	0.75	1 (5%)	23,30,33	1.33	3 (13%)
1	H2U	B	20	1	17,21,22	0.73	0	23,30,33	1.30	1 (4%)
1	AET	B	37	1	22,35,36	1.52	4 (18%)	25,51,54	2.55	9 (36%)
1	G7M	B	46	1	17,26,27	1.29	3 (17%)	19,39,42	2.67	3 (15%)
1	5MU	B	54	1	12,22,23	1.31	2 (16%)	14,32,35	4.23	3 (21%)
1	PSU	B	55	1	13,21,22	2.71	4 (30%)	18,30,33	5.83	3 (16%)

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	H2U	B	16	1	-	0/7/38/39	0/2/2/2
1	H2U	B	17	1	-	0/7/38/39	0/2/2/2
1	H2U	B	20	1	-	0/7/38/39	0/2/2/2
1	AET	B	37	1	-	1/18/45/46	0/3/3/3
1	G7M	B	46	1	-	0/3/25/26	0/3/3/3
1	5MU	B	54	1	-	0/3/25/26	0/2/2/2
1	PSU	B	55	1	-	0/7/25/26	0/2/2/2

The worst 5 of 15 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	55	PSU	C5-C1'	-7.30	1.45	1.52
1	B	55	PSU	C6-N1	-5.12	1.23	1.34
1	B	37	AET	CM6-N6	-3.24	1.40	1.46
1	B	55	PSU	C6-C5	-2.78	1.34	1.38
1	B	37	AET	O10-C10	2.08	1.27	1.23

The worst 5 of 24 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	55	PSU	N1-C2-N3	-21.09	114.88	128.33
1	B	46	G7M	C5-C6-N1	-8.87	111.47	123.59
1	B	54	5MU	C5-C4-N3	-8.48	115.69	125.14

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	37	AET	O3'-C3'-C2'	-5.17	95.02	111.83
1	B	17	H2U	N3-C2-N1	-4.24	112.36	116.60

There are no chirality outliers.

All (1) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
1	B	37	AET	N1-C6-N6-CM6

There are no ring outliers.

1 monomer is involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
1	B	17	H2U	2	0

5.5 Carbohydrates [i](#)

There are no carbohydrates in this entry.

5.6 Ligand geometry [i](#)

Of 2 ligands modelled in this entry, 1 is monoatomic - leaving 1 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	$\# Z > 2$
4	AMP	A	1002	-	20,25,25	0.81	0	22,38,38	0.96	1 (4%)

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
4	AMP	A	1002	-	-	0/6/26/26	0/3/3/3

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
4	A	1002	AMP	O2P-P-O1P	2.89	119.88	110.58

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

1 monomer is involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
4	A	1002	AMP	2	0

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 ⓘ

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	B	69/76 (90%)	-0.46	0	100 100	29, 46, 86, 94	0
2	A	641/642 (99%)	-0.41	1 (0%)	95 95	23, 49, 81, 97	0
All	All	710/718 (98%)	-0.41	1 (0%)	95 96	23, 49, 83, 97	0

All (1) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	A	182	CYS	2.5

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	RSCC	RSR	LLDF	B-factors(Å ²)	Q<0.9
1	H2U	B	17	20/21	0.83	0.25	-	84,98,100,100	0
1	AET	B	37	33/34	0.90	0.17	-	84,90,100,100	0
1	5MU	B	54	21/22	0.98	0.12	-	17,36,47,49	0
1	H2U	B	16	20/21	0.79	0.51	-	83,100,100,100	0
1	H2U	B	20	20/21	0.96	0.13	-	50,55,58,61	0
1	PSU	B	55	20/21	0.98	0.10	-	31,45,52,53	0
1	G7M	B	46	24/25	0.97	0.12	-	43,48,62,64	0

6.3 Carbohydrates ⓘ

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(\AA^2)	Q<0.9
4	AMP	A	1002	23/23	0.98	0.26	0.88	35,39,42,43	0
3	ZN	A	1001	1/1	0.99	0.22	-	38,38,38,38	0

6.5 Other polymers [i](#)

There are no such residues in this entry.