



wwPDB X-ray Structure Validation Summary Report ⓘ

Mar 8, 2026 – 05:10 PM UTC

PDB ID : 5XQ2 / pdb_00005xq2
Title : Crystal structure of T. thermophilus Argonaute protein complexed with a bulge 5A6 on the guide strand
Authors : Sheng, G.; Gogakos, T.; Wang, J.; Zhao, H.; Serganov, A.; Juranek, S.; Tuschl, T.; Patel, D.; Wang, Y.
Deposited on : 2017-06-06
Resolution : 3.33 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)	:	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

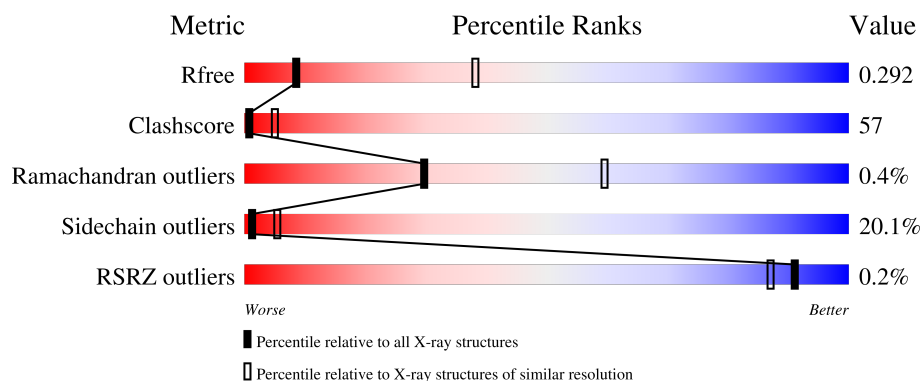
1 Overall quality at a glance ⓘ

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 3.33 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.



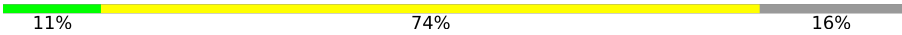
Metric	Whole archive (#Entries)	Similar resolution (#Entries, resolution range(Å))
R_{free}	180053	1434 (3.38-3.30)
Clashscore	190562	1479 (3.38-3.30)
Ramachandran outliers	187476	1456 (3.38-3.30)
Sidechain outliers	187428	1455 (3.38-3.30)
RSRZ outliers	180081	1434 (3.38-3.30)

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	685	40% 43% 14% ..
1	B	685	40% 46% 12% ..
2	E	22	9% 64% 5% 23%
2	X	22	9% 59% 9% 23%
3	F	19	26% 58% 16%

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Mol	Chain	Length	Quality of chain
3	Y	19	
4	C	3	
4	D	3	

2 Entry composition [i](#)

There are 6 unique types of molecules in this entry. The entry contains 11844 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 TtAgo (D546N).

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	679	Total	C	N	O	S	0	0	0
			5184	3317	967	895	5			
1	B	679	Total	C	N	O	S	0	0	0
			5185	3318	968	893	6			

There are 2 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	546	ASN	ASP	engineered mutation	UNP Q746M7
B	546	ASN	ASP	engineered mutation	UNP Q746M7

- Molecule 2 is a DNA chain called DNA (5'-D(P*TP*GP*AP*AP*GP*AP*TP*AP*GP*TP*AP*GP*GP*TP*TP*GP*T)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
2	X	17	Total	C	N	O	P	0	0	0
			359	170	67	105	17			
2	E	17	Total	C	N	O	P	0	0	0
			359	170	67	105	17			

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

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
3	Y	16	Total	C	N	O	P	0	0	0
			317	153	57	92	15			
3	F	16	Total	C	N	O	P	0	0	0
			317	153	57	92	15			

- Molecule 4 is a DNA chain called DNA (5'-D(*AP*GP*T)-3').

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
4	C	3	Total	C	N	O	P	0	0	0
			59	30	12	15	2			
4	D	3	Total	C	N	O	P	0	0	0
			59	30	12	15	2			

- Molecule 5 is MAGNESIUM ION (CCD ID: MG) (formula: Mg).

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
5	X	1	Total	Mg	0	0
			1	1		
5	E	1	Total	Mg	0	0
			1	1		

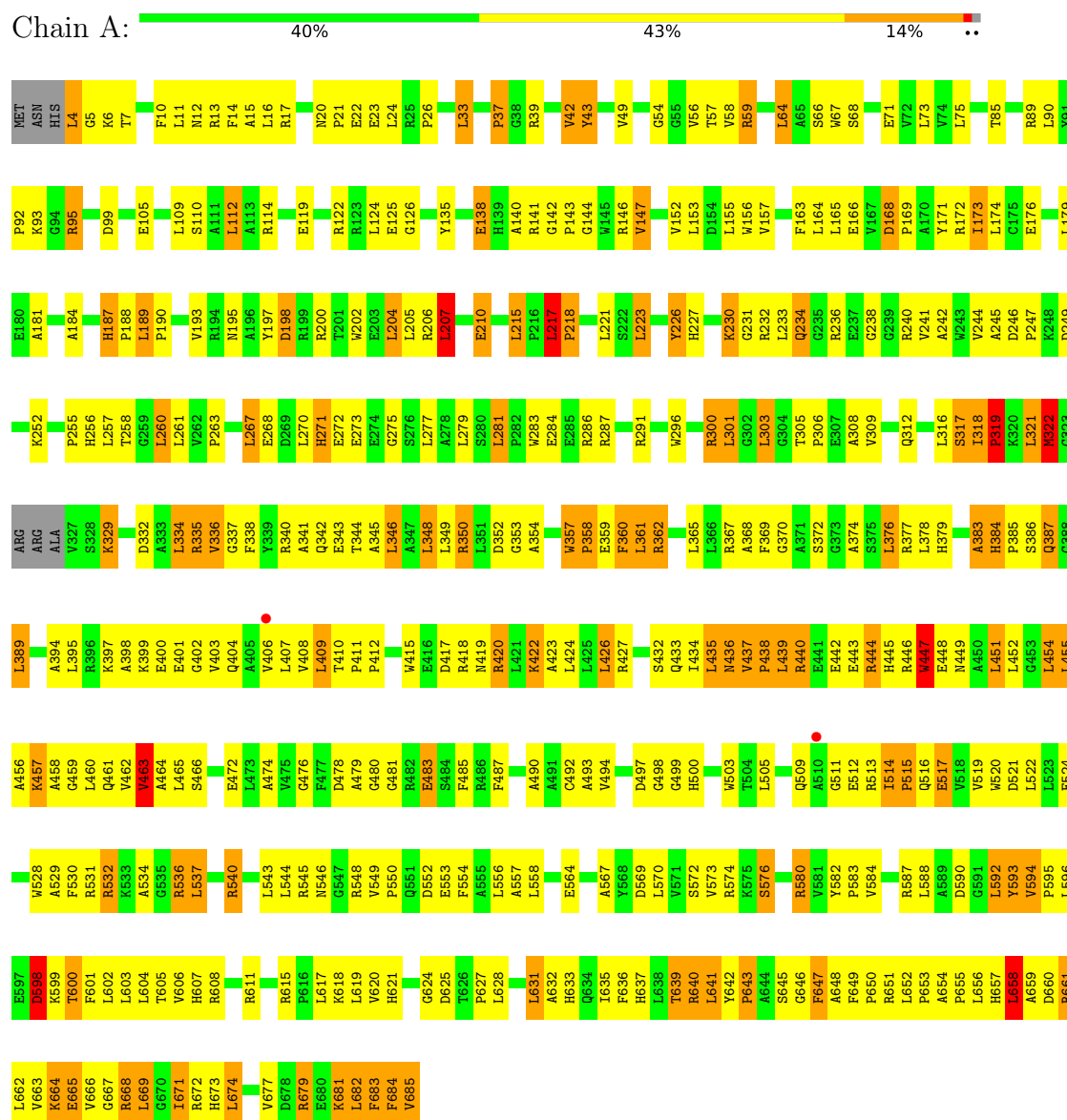
- Molecule 6 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
6	A	1	Total	O	0	0
			1	1		
6	B	2	Total	O	0	0
			2	2		

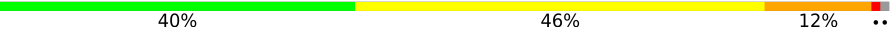
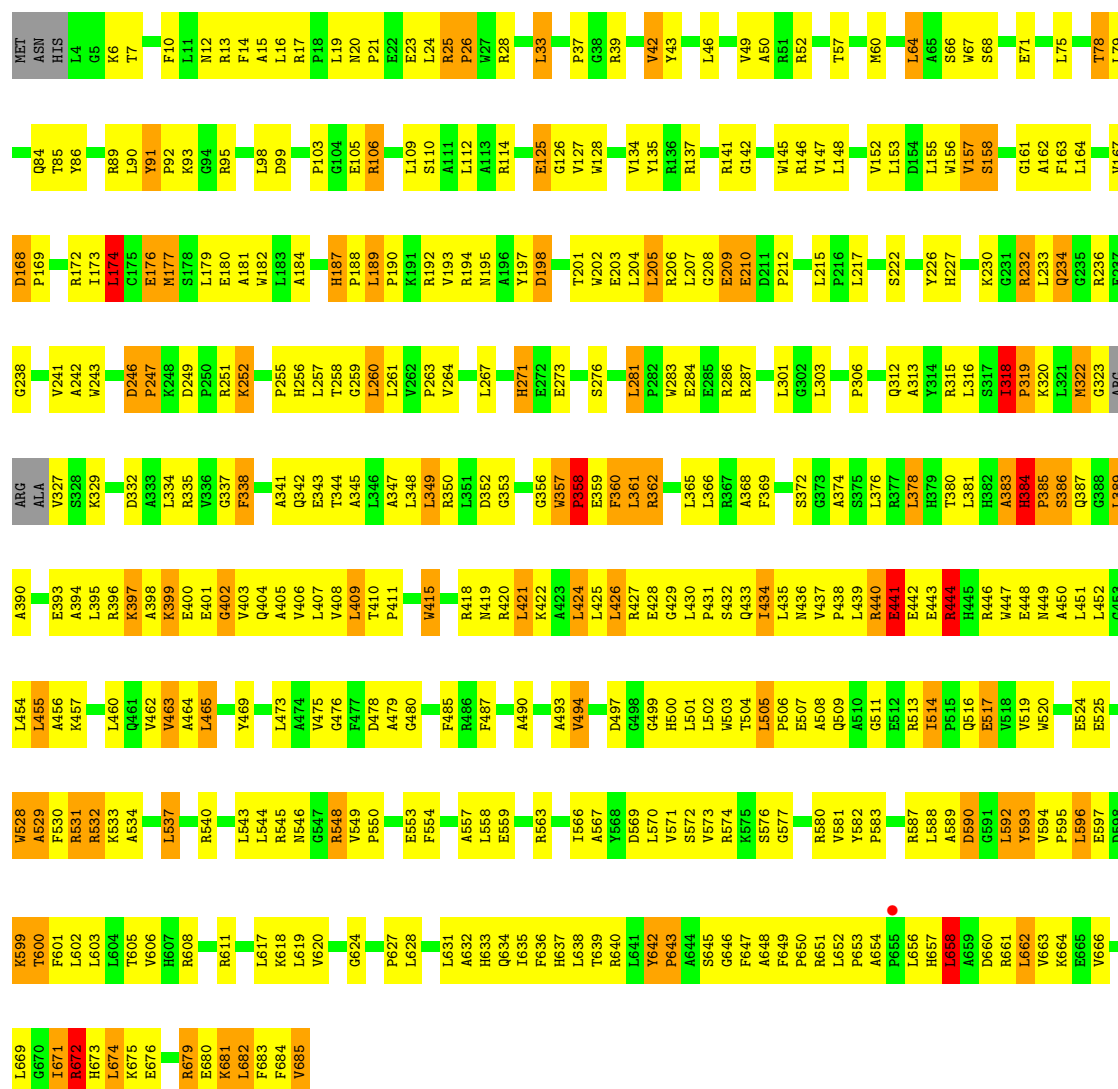
3 Residue-property plots

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.

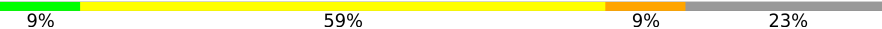
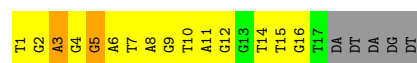
• Molecule 1: TtAgo (D546N)



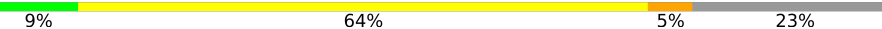
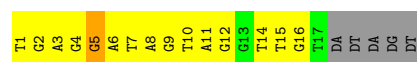
• Molecule 1: TtAgo (D546N)

Chain B:  40% 46% 12% ..

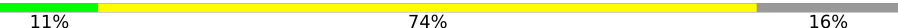
• Molecule 2: DNA (5'-D(P*TP*GP*AP*AP*GP*AP*TP*AP*GP*TP*AP*GP*GP*TP*TP*G P*T)-3')

Chain X:  9% 59% 9% 23%

• Molecule 2: DNA (5'-D(P*TP*GP*AP*AP*GP*AP*TP*AP*GP*TP*AP*GP*GP*TP*TP*G P*T)-3')

Chain E:  9% 64% 5% 23%

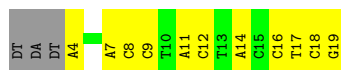
- Molecule 3: DNA (5'-D(*AP*CP*AP*AP*CP*CP*TP*AP*CP*TP*AP*CP*CP*TP*CP*G)-3')

Chain Y:  11% 74% 16%



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

Chain F:  26% 58% 16%



- Molecule 4: DNA (5'-D(*AP*GP*T)-3')

Chain C:  67% 33%



- Molecule 4: DNA (5'-D(*AP*GP*T)-3')

Chain D:  67% 33%



4 Data and refinement statistics

Property	Value	Source
Space group	P 21 3	Depositor
Cell constants a, b, c, α , β , γ	201.84Å 201.84Å 201.84Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	48.95 – 3.33 48.95 – 3.33	Depositor EDS
% Data completeness (in resolution range)	92.1 (48.95-3.33) 92.8 (48.95-3.33)	Depositor EDS
R_{merge}	0.11	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	5.65 (at 3.33Å)	Xtriage
Refinement program	PHENIX 1.10.1_2155	Depositor
R, R_{free}	0.252 , 0.294 0.253 , 0.292	Depositor DCC
R_{free} test set	1846 reflections (4.56%)	wwPDB-VP
Wilson B-factor (Å ²)	47.8	Xtriage
Anisotropy	0.000	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.34 , 257.0	EDS
L-test for twinning ²	$\langle L \rangle = 0.42$, $\langle L^2 \rangle = 0.25$	Xtriage
Estimated twinning fraction	0.459 for l,-k,h	Xtriage
F_o, F_c correlation	0.83	EDS
Total number of atoms	11844	wwPDB-VP
Average B, all atoms (Å ²)	57.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 1.82% 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 [i](#)

5.1 Standard geometry [i](#)

Bond lengths and bond angles in the following residue types are not validated in this section: MG

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	0.75	19/5312 (0.4%)	1.06	42/7233 (0.6%)
1	B	0.73	18/5312 (0.3%)	1.03	39/7229 (0.5%)
2	E	0.80	1/403 (0.2%)	0.81	0/621
2	X	0.84	2/403 (0.5%)	0.82	0/621
3	F	0.63	0/354	0.74	0/542
3	Y	0.64	0/354	0.74	0/542
4	C	0.45	0/66	0.62	0/101
4	D	0.53	0/66	0.65	0/101
All	All	0.74	40/12270 (0.3%)	1.01	81/16990 (0.5%)

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	0	2

The worst 5 of 40 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	642	TYR	C-N	8.96	1.41	1.33
1	B	384	HIS	C-N	7.25	1.41	1.34
1	B	25	ARG	C-N	6.36	1.41	1.33
1	A	410	THR	C-N	6.31	1.40	1.33
1	B	318	ILE	C-N	6.05	1.40	1.33

The worst 5 of 81 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	402	GLY	N-CA-C	12.44	129.21	114.16
1	A	437	VAL	C-N-CD	8.22	138.68	120.60
1	A	321	LEU	N-CA-C	-7.79	100.25	110.53
1	B	444	ARG	N-CA-C	7.75	119.80	111.36
1	B	577	GLY	N-CA-C	-7.68	102.37	111.36

There are no chirality outliers.

All (2) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	B	125	GLU	Peptide
1	B	203	GLU	Peptide

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	A	5184	0	5154	632	2
1	B	5185	0	5161	643	0
2	E	359	0	194	28	0
2	X	359	0	194	26	0
3	F	317	0	181	15	0
3	Y	317	0	179	23	0
4	C	59	0	33	11	0
4	D	59	0	33	2	0
5	E	1	0	0	0	0
5	X	1	0	0	0	0
6	A	1	0	0	0	0
6	B	2	0	0	0	0
All	All	11844	0	11129	1302	2

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 57.

The worst 5 of 1302 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:A:319:PRO:HB3	1:A:637:HIS:CD2	1.25	1.65
1:B:455:LEU:HD22	1:B:460:LEU:CD2	1.18	1.60
1:B:455:LEU:CD2	1:B:460:LEU:HD23	1.15	1.56
1:A:426:LEU:HD11	1:A:677:VAL:CG2	1.47	1.43
1:B:658:LEU:HD12	1:B:684:PHE:CE2	1.53	1.42

All (2) 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)
1:A:367:ARG:NH1	1:A:437:VAL:CG1[9_555]	1.75	0.45
1:A:353:GLY:O	1:A:370:GLY:CA[5_555]	2.18	0.02

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	675/685 (98%)	654 (97%)	18 (3%)	3 (0%)	30	59
1	B	675/685 (98%)	650 (96%)	22 (3%)	3 (0%)	30	59
All	All	1350/1370 (98%)	1304 (97%)	40 (3%)	6 (0%)	30	59

5 of 6 Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	25	ARG
1	B	358	PRO
1	A	37	PRO
1	A	385	PRO
1	A	319	PRO

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	499/549 (91%)	386 (77%)	113 (23%)	1	4
1	B	498/549 (91%)	411 (82%)	87 (18%)	2	9
All	All	997/1098 (91%)	797 (80%)	200 (20%)	1	5

5 of 200 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	B	33	LEU
1	B	281	LEU
1	B	685	VAL
1	B	78	THR
1	B	180	GLU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 9 such sidechains are listed below:

Mol	Chain	Res	Type
1	B	633	HIS
1	B	657	HIS
1	A	657	HIS
1	B	20	ASN
1	B	312	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](#)

Of 2 ligands modelled in this entry, 2 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 [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	679/685 (99%)	-0.75	2 (0%) 90 83	12, 56, 106, 149	0
1	B	679/685 (99%)	-0.73	1 (0%) 92 91	12, 56, 103, 137	0
2	E	17/22 (77%)	-1.34	0 100 100	26, 40, 62, 63	0
2	X	17/22 (77%)	-1.29	0 100 100	25, 36, 60, 68	0
3	F	16/19 (84%)	-1.13	0 100 100	38, 54, 63, 71	0
3	Y	16/19 (84%)	-1.23	0 100 100	36, 48, 57, 60	0
4	C	3/3 (100%)	-1.00	0 100 100	48, 48, 72, 100	0
4	D	3/3 (100%)	-1.14	0 100 100	48, 48, 85, 110	0
All	All	1430/1458 (98%)	-0.77	3 (0%) 91 87	12, 55, 104, 149	0

All (3) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	510	ALA	2.7
1	B	655	PRO	2.4
1	A	406	VAL	2.2

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
5	MG	E	101	1/1	0.94	0.07	35,35,35,35	0
5	MG	X	101	1/1	0.97	0.07	51,51,51,51	0

6.5 Other polymers [i](#)

There are no such residues in this entry.