



Full wwPDB X-ray Structure Validation Report ⓘ

Sep 11, 2023 – 10:21 PM EDT

PDB ID : 4MN4
Title : Structural Basis for the MukB-topoisomerase IV Interaction
Authors : Vos, S.M.; Stewart, N.K.; Oakley, M.G.; Berger, J.M.
Deposited on : 2013-09-09
Resolution : 2.30 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 : 4.02b-467
Mogul : 1.8.5 (274361), CSD as541be (2020)
Xtrriage (Phenix) : 1.13
EDS : 2.35.1
Percentile statistics : 20191225.v01 (using entries in the PDB archive December 25th 2019)
Refmac : 5.8.0158
CCP4 : 7.0.044 (Gargrove)
Ideal geometry (proteins) : Engh & Huber (2001)
Ideal geometry (DNA, RNA) : Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP) : 2.35.1

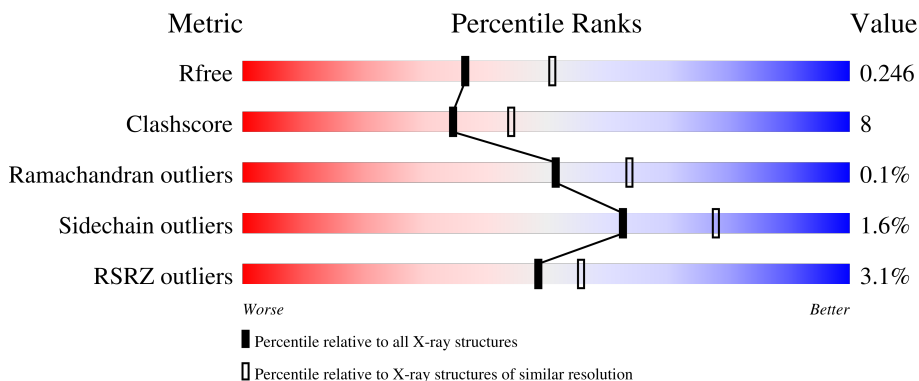
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

The reported resolution of this entry is 2.30 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}	130704	5042 (2.30-2.30)
Clashscore	141614	5643 (2.30-2.30)
Ramachandran outliers	138981	5575 (2.30-2.30)
Sidechain outliers	138945	5575 (2.30-2.30)
RSRZ outliers	127900	4938 (2.30-2.30)

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	259	
1	B	259	
2	C	163	
2	D	163	

2 Entry composition [i](#)

There are 3 unique types of molecules in this entry. The entry contains 6542 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 DNA topoisomerase 4 subunit A.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	N	O	S	Se			
1	A	246	Total	C	N	O	S	Se	0	3	0
			1875	1179	334	351	1	10			
1	B	245	Total	C	N	O	S	Se	0	7	0
			1881	1182	332	355	1	11			

There are 6 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	494	SER	-	expression tag	UNP P0AFI2
A	495	ASN	-	expression tag	UNP P0AFI2
A	496	ALA	-	expression tag	UNP P0AFI2
B	494	SER	-	expression tag	UNP P0AFI2
B	495	ASN	-	expression tag	UNP P0AFI2
B	496	ALA	-	expression tag	UNP P0AFI2

- Molecule 2 is a protein called Chromosome partition protein MukB.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	C	159	Total	C	N	O	S	0	4	0
			1287	804	222	260	1			
2	D	154	Total	C	N	O	S	0	4	0
			1248	782	213	252	1			

There are 6 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
C	642	SER	-	expression tag	UNP P22523
C	643	ASN	-	expression tag	UNP P22523
C	644	ALA	-	expression tag	UNP P22523
D	642	SER	-	expression tag	UNP P22523
D	643	ASN	-	expression tag	UNP P22523
D	644	ALA	-	expression tag	UNP P22523


- Molecule 3 is water.

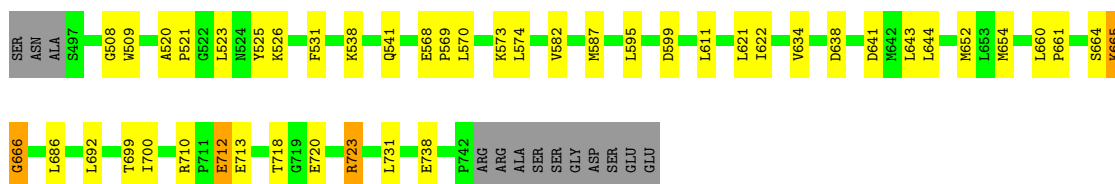
Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	71	Total 71	O 71	0	0
3	C	58	Total 58	O 58	0	0
3	D	46	Total 46	O 46	0	0
3	B	76	Total 76	O 76	0	0

3 Residue-property plots [i](#)


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.

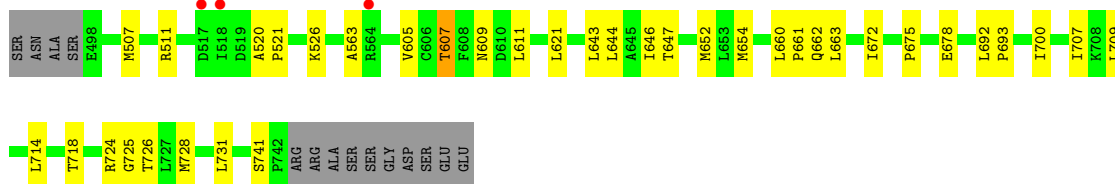
- Molecule 1: DNA topoisomerase 4 subunit A

Chain A: 




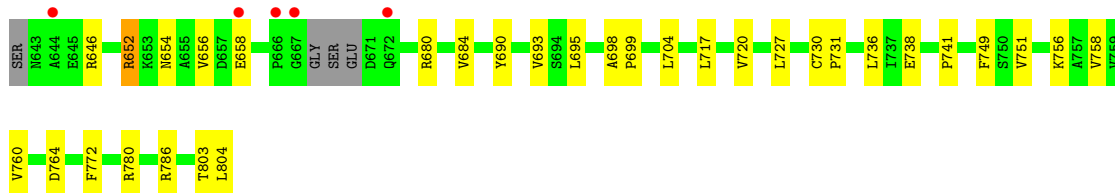
- Molecule 1: DNA topoisomerase 4 subunit A

Chain B: 



- Molecule 2: Chromosome partition protein MukB

Chain C: 



- Molecule 2: Chromosome partition protein MukB

Chain D: 





4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α , β , γ	49.77Å 103.74Å 186.61Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	49.97 – 2.30 49.97 – 2.30	Depositor EDS
% Data completeness (in resolution range)	98.1 (49.97-2.30) 97.7 (49.97-2.30)	Depositor EDS
R_{merge}	0.06	Depositor
R_{sym}	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.06 (at 2.29Å)	Xtrriage
Refinement program	PHENIX (phenix.refine: 1.8.2_1309)	Depositor
R, R_{free}	0.204 , 0.246 0.204 , 0.246	Depositor DCC
R_{free} test set	2170 reflections (5.04%)	wwPDB-VP
Wilson B-factor (Å ²)	35.3	Xtrriage
Anisotropy	0.123	Xtrriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.31 , 37.8	EDS
L-test for twinning ²	$\langle L \rangle = 0.49$, $\langle L^2 \rangle = 0.33$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
F_o, F_c correlation	0.94	EDS
Total number of atoms	6542	wwPDB-VP
Average B, all atoms (Å ²)	37.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.77% 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](#)

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	0.26	0/1904	0.41	0/2560
1	B	0.27	0/1925	0.39	0/2589
2	C	0.34	0/1322	0.40	0/1790
2	D	0.21	0/1283	0.36	0/1737
All	All	0.27	0/6434	0.39	0/8676

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

There are no planarity outliers.

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	1875	0	1940	35	0
1	B	1881	0	1945	29	0
2	C	1287	0	1239	18	0
2	D	1248	0	1202	23	0
3	A	71	0	0	0	0
3	B	76	0	0	0	0
3	C	58	0	0	1	0
3	D	46	0	0	0	0
All	All	6542	0	6326	105	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 8.

All (105) 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:652:MSE:HB2	1:B:728[A]:MSE:HE3	1.51	0.91
1:A:538:LYS:H	1:A:541:GLN:HE21	1.19	0.85
2:C:803:THR:O	2:C:804:LEU:HB2	1.83	0.79
2:C:751:VAL:HG22	2:C:760:VAL:HG22	1.65	0.78
1:A:720:GLU:HB2	1:A:723:ARG:HE	1.51	0.74
1:B:724:ARG:HB3	1:B:725:GLY:HA2	1.70	0.74
1:A:699:THR:HB	1:A:738:GLU:HB2	1.71	0.72
1:A:570:LEU:HD23	1:A:582:VAL:HG21	1.75	0.68
2:D:756:LYS:HA	2:D:772:PHE:CD2	2.31	0.66
2:D:795:GLU:HG2	2:D:796:VAL:N	2.08	0.66
1:B:654:MSE:HE2	1:B:718:THR:HG22	1.77	0.66
1:A:710:ARG:N	1:A:713:GLU:OE1	2.28	0.65
2:D:717:LEU:HG	2:D:738:GLU:HB2	1.79	0.64
1:A:664:SER:O	1:A:665:LYS:HG3	1.97	0.63
1:A:611:LEU:HG	1:A:621:LEU:HD22	1.81	0.63
1:A:538:LYS:N	1:A:541:GLN:HE21	1.94	0.63
1:B:652:MSE:HB2	1:B:728[A]:MSE:CE	2.26	0.63
2:C:654:ASN:O	2:C:658:GLU:HG2	1.99	0.62
1:B:654:MSE:HE2	1:B:718:THR:CG2	2.30	0.61
1:B:507[A]:MSE:SE	1:B:526:LYS:HE3	2.55	0.57
2:D:680:ARG:HD3	2:D:723:HIS:CD2	2.39	0.57
1:A:654:MSE:HE2	1:A:718:THR:OG1	2.03	0.57
2:C:646:ARG:HG3	2:C:804:LEU:HD13	1.87	0.57
1:B:724:ARG:HB3	1:B:725:GLY:CA	2.35	0.56
2:D:776:PRO:HG2	2:D:783:ARG:HH21	1.71	0.56
1:A:720:GLU:HB3	1:A:723:ARG:HH21	1.70	0.56
1:A:538:LYS:H	1:A:541:GLN:NE2	1.98	0.55
2:D:645:GLU:HG2	2:D:646:ARG:H	1.72	0.55
1:A:622:ILE:HA	1:A:666:GLY:O	2.08	0.54
2:D:698:ALA:HB3	2:D:699:PRO:HD3	1.88	0.54
1:B:644:LEU:HD11	1:B:652:MSE:HE3	1.88	0.54
1:B:709:LEU:HD12	1:B:709:LEU:N	2.22	0.54
2:D:652:ARG:HG3	2:D:797:LEU:HD11	1.89	0.54
1:A:520:ALA:HB3	1:A:521:PRO:HD3	1.90	0.54
1:B:662:GLN:C	1:B:663:LEU:HD12	2.29	0.53
2:C:751:VAL:HG13	2:C:758:VAL:HG13	1.91	0.53
1:B:511:ARG:HD2	1:B:563:ALA:HA	1.90	0.53
1:A:720:GLU:CB	1:A:723:ARG:HH21	2.22	0.53
1:A:644:LEU:HD11	1:A:652:MSE:HE2	1.91	0.52
1:A:664:SER:C	1:A:665:LYS:HG3	2.29	0.52

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:541:GLN:HG3	1:A:587:MSE:HE2	1.91	0.52
1:B:611:LEU:HG	1:B:621:LEU:HD22	1.90	0.52
1:B:646:ILE:HG12	1:B:652:MSE:HG2	1.91	0.52
2:C:717:LEU:HG	2:C:738:GLU:HB2	1.90	0.52
2:C:756:LYS:HB3	2:C:772:PHE:CD2	2.44	0.51
1:B:605:VAL:O	1:B:662:GLN:HG3	2.11	0.51
2:D:677:LEU:HD23	2:D:680:ARG:NH2	2.25	0.51
1:B:520:ALA:HB3	1:B:521:PRO:HD3	1.92	0.51
1:A:570:LEU:HG	1:A:574:LEU:HD12	1.92	0.51
2:C:720:VAL:HG11	2:C:736:LEU:HD13	1.92	0.50
1:B:607:THR:HG22	1:B:609:ASN:H	1.77	0.50
2:C:698:ALA:HB3	2:C:699:PRO:HD3	1.94	0.50
1:B:660:LEU:HD12	1:B:661:PRO:HD2	1.95	0.49
2:C:749:PHE:HB3	2:C:751:VAL:HG23	1.95	0.49
2:D:662:ARG:O	2:D:665:GLN:HB3	2.12	0.49
2:D:661:GLU:O	2:D:665:GLN:HB2	2.14	0.48
2:D:730:CYS:HB2	2:D:731:PRO:HD2	1.96	0.48
1:A:710:ARG:HB2	1:A:712:GLU:HG2	1.95	0.48
2:C:690:TYR:O	2:C:693:VAL:HG22	2.13	0.47
2:D:796:VAL:O	2:D:799:GLU:HG3	2.14	0.47
1:B:726:THR:O	1:B:728[A]:MSE:HE2	2.15	0.47
1:B:607:THR:HG22	1:B:609:ASN:N	2.30	0.46
1:B:707:ILE:N	1:B:707:ILE:HD12	2.30	0.46
1:A:525:TYR:OH	1:A:531:PHE:HB2	2.16	0.45
2:C:730:CYS:HB2	2:C:731:PRO:HD2	1.98	0.45
1:A:595:LEU:HB3	1:A:634:VAL:HB	1.98	0.45
1:A:599:ASP:HA	1:A:686[B]:LEU:HB2	1.97	0.45
2:D:783:ARG:O	2:D:787:ILE:HG13	2.16	0.45
2:D:693[A]:VAL:CG2	2:D:697:ASP:HB2	2.47	0.45
1:B:607:THR:CG2	1:B:609:ASN:H	2.31	0.44
1:B:714:LEU:O	1:B:718:THR:HG23	2.17	0.44
2:D:666:PRO:HA	2:D:667:GLY:HA2	1.74	0.44
2:D:780:ARG:HA	2:D:783:ARG:NH1	2.33	0.43
2:D:683:GLY:HA3	2:D:714:VAL:HG12	1.99	0.43
1:A:638:ASP:HB3	1:A:641:ASP:OD1	2.19	0.43
2:C:780:ARG:HD2	3:C:936:HOH:O	2.18	0.43
1:B:644:LEU:HD11	1:B:652:MSE:CE	2.48	0.43
2:C:704:LEU:CD1	2:C:751:VAL:HG21	2.48	0.43
1:B:643:LEU:C	1:B:643:LEU:HD23	2.39	0.43
1:A:570:LEU:HD12	1:A:570:LEU:HA	1.89	0.42
2:C:684:VAL:CG2	2:C:741:PRO:HB3	2.50	0.42

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:693:PRO:HG2	1:B:741:SER:HB3	2.02	0.42
1:B:700:ILE:HG21	1:B:731:LEU:HD11	2.02	0.42
1:B:724:ARG:CB	1:B:725:GLY:HA2	2.38	0.42
2:D:720:VAL:HG11	2:D:736:LEU:HD13	2.02	0.42
1:A:509:TRP:CZ2	1:A:569:PRO:HG3	2.54	0.42
1:A:700:ILE:HG21	1:A:731:LEU:HD11	2.02	0.42
1:A:660:LEU:HD12	1:A:661:PRO:HD2	2.01	0.42
1:A:568:GLU:OE2	1:A:573:LYS:HE2	2.19	0.42
2:C:680[B]:ARG:NH1	2:C:727:LEU:HD13	2.34	0.41
2:C:652:ARG:O	2:C:656:VAL:HG23	2.20	0.41
2:D:714:VAL:O	2:D:738:GLU:HA	2.20	0.41
1:B:675:PRO:HB2	1:B:678:GLU:HG3	2.03	0.41
1:B:647:THR:HG23	1:B:672:ILE:HD13	2.02	0.41
1:A:520:ALA:O	1:A:523:LEU:HB2	2.21	0.41
2:C:695:LEU:HD11	2:C:786:ARG:HG2	2.02	0.41
2:D:652:ARG:HG3	2:D:797:LEU:CD1	2.50	0.41
2:D:793:GLU:O	2:D:797:LEU:HG	2.20	0.41
1:A:643:LEU:C	1:A:643:LEU:HD23	2.41	0.41
1:A:508:GLY:O	1:A:570:LEU:HB2	2.21	0.40
2:D:690:TYR:O	2:D:693[B]:VAL:HG22	2.22	0.40
1:A:523:LEU:HD12	1:A:523:LEU:HA	1.91	0.40
1:A:621:LEU:O	1:A:666:GLY:HA2	2.22	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	247/259 (95%)	242 (98%)	4 (2%)	1 (0%)	34	42
1	B	250/259 (96%)	242 (97%)	8 (3%)	0	100	100
2	C	159/163 (98%)	157 (99%)	2 (1%)	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
2	D	154/163 (94%)	149 (97%)	5 (3%)	0	100	100
All	All	810/844 (96%)	790 (98%)	19 (2%)	1 (0%)	51	64

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	666	GLY

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	205/203 (101%)	201 (98%)	4 (2%)	55	72
1	B	208/203 (102%)	206 (99%)	2 (1%)	76	87
2	C	141/140 (101%)	139 (99%)	2 (1%)	67	81
2	D	138/140 (99%)	135 (98%)	3 (2%)	52	69
All	All	692/686 (101%)	681 (98%)	11 (2%)	62	78

All (11) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	665	LYS
1	A	692	LEU
1	A	712	GLU
1	A	723	ARG
2	C	652	ARG
2	C	764	ASP
2	D	680	ARG
2	D	795	GLU
2	D	798	SER
1	B	607	THR
1	B	692	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (8) such

sidechains are listed below:

Mol	Chain	Res	Type
1	A	541	GLN
1	A	566	GLN
1	A	673	ASN
1	A	732	GLN
2	C	665	GLN
2	D	672	GLN
2	D	723	HIS
1	B	688	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 monosaccharides in this entry.

5.6 Ligand geometry [i](#)

There are no ligands in this entry.

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	A	237/259 (91%)	-0.08	0 100 100	17, 33, 68, 78	0
1	B	236/259 (91%)	-0.16	3 (1%) 77 81	14, 30, 59, 81	0
2	C	159/163 (97%)	0.06	5 (3%) 49 56	16, 33, 66, 96	0
2	D	154/163 (94%)	0.43	16 (10%) 6 9	18, 37, 93, 106	0
All	All	786/844 (93%)	0.03	24 (3%) 49 56	14, 32, 72, 106	0

All (24) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
2	D	651	ALA	5.5
2	D	801	PHE	4.6
2	D	650	GLY	4.5
2	D	799	GLU	3.8
2	C	667	GLY	3.4
2	D	658	GLU	3.4
2	D	797	LEU	3.3
2	D	796	VAL	3.3
2	C	672	GLN	3.1
2	D	800	ARG	3.1
2	D	795	GLU	2.9
2	D	649	VAL	2.9
2	D	666	PRO	2.7
1	B	564	ARG	2.4
2	C	658	GLU	2.3
2	D	672	GLN	2.3
2	C	666	PRO	2.3
2	D	648	GLU	2.3
1	B	518	ILE	2.2
2	D	646	ARG	2.2
2	D	657	ASP	2.1

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Mol	Chain	Res	Type	RSRZ
2	D	794	ARG	2.1
1	B	517	ASP	2.0
2	C	644	ALA	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 monosaccharides in this entry.

6.4 Ligands [i](#)

There are no ligands in this entry.

6.5 Other polymers [i](#)

There are no such residues in this entry.