



# Full wwPDB X-ray Structure Validation Report ⓘ

May 22, 2020 – 12:13 am BST

PDB ID : 4P7I  
Title : Crystal structure of the Merlin FERM/DCAF1 complex  
Authors : Wei, Z.; Li, Y.; Zhang, M.  
Deposited on : 2014-03-27  
Resolution : 2.60 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](mailto: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.

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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)  
Xtriage (Phenix) : 1.13  
EDS : 2.11  
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) : 2.11

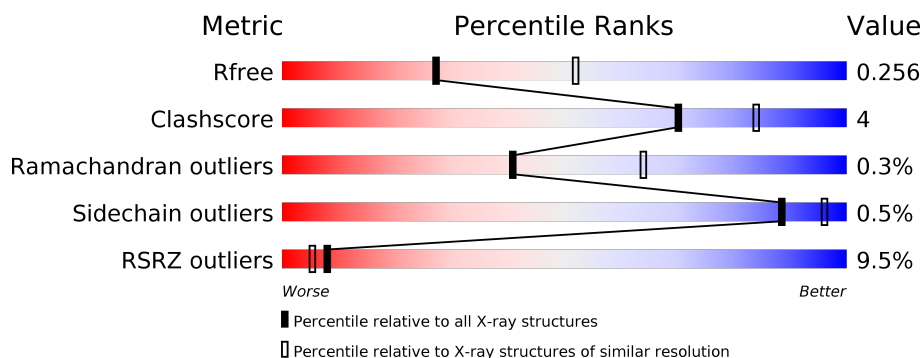
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 2.60 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	3163 (2.60-2.60)
Clashscore	141614	3518 (2.60-2.60)
Ramachandran outliers	138981	3455 (2.60-2.60)
Sidechain outliers	138945	3455 (2.60-2.60)
RSRZ outliers	127900	3104 (2.60-2.60)

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  $\geq 3$ , 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	317	<div> <div>2%</div> <div>84%</div> <div>9%</div> <div>7%</div> </div>
1	B	317	<div> <div>13%</div> <div>81%</div> <div>10%</div> <div>8%</div> </div>
2	C	67	<div> <div>7%</div> <div>13%</div> <div>9%</div> <div>78%</div> </div>
2	D	67	<div> <div>7%</div> <div>9%</div> <div>90%</div> </div>

## 2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 5107 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 Merlin.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	294	Total	C	N	O	S	0	0	0
			2458	1592	411	442	13			
1	B	292	Total	C	N	O	S	0	0	0
			2442	1581	408	440	13			

There are 8 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-3	GLY	-	expression tag	UNP P46662
A	-2	PRO	-	expression tag	UNP P46662
A	-1	GLY	-	expression tag	UNP P46662
A	0	SER	-	expression tag	UNP P46662
B	-3	GLY	-	expression tag	UNP P46662
B	-2	PRO	-	expression tag	UNP P46662
B	-1	GLY	-	expression tag	UNP P46662
B	0	SER	-	expression tag	UNP P46662

- Molecule 2 is a protein called Protein VPRBP.

Mol	Chain	Residues	Atoms				ZeroOcc	AltConf	Trace
2	C	15	Total	C	N	O	0	0	0
			116	75	16	25			
2	D	7	Total	C	N	O	0	0	0
			54	35	8	11			

There are 12 discrepancies between the modelled and reference sequences:

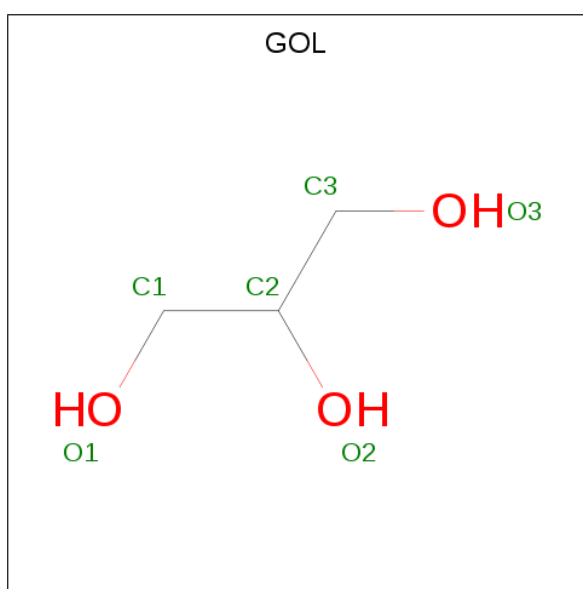
Chain	Residue	Modelled	Actual	Comment	Reference
C	1441	GLY	-	expression tag	UNP Q9Y4B6
C	1442	PRO	-	expression tag	UNP Q9Y4B6
C	1443	GLY	-	expression tag	UNP Q9Y4B6
C	1444	SER	-	expression tag	UNP Q9Y4B6

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Chain	Residue	Modelled	Actual	Comment	Reference
C	1445	GLU	-	expression tag	UNP Q9Y4B6
C	1446	PHE	-	expression tag	UNP Q9Y4B6
D	1441	GLY	-	expression tag	UNP Q9Y4B6
D	1442	PRO	-	expression tag	UNP Q9Y4B6
D	1443	GLY	-	expression tag	UNP Q9Y4B6
D	1444	SER	-	expression tag	UNP Q9Y4B6
D	1445	GLU	-	expression tag	UNP Q9Y4B6
D	1446	PHE	-	expression tag	UNP Q9Y4B6

- Molecule 3 is GLYCEROL (three-letter code: GOL) (formula:  $C_3H_8O_3$ ).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	C	O	0	0
			6	3	3		

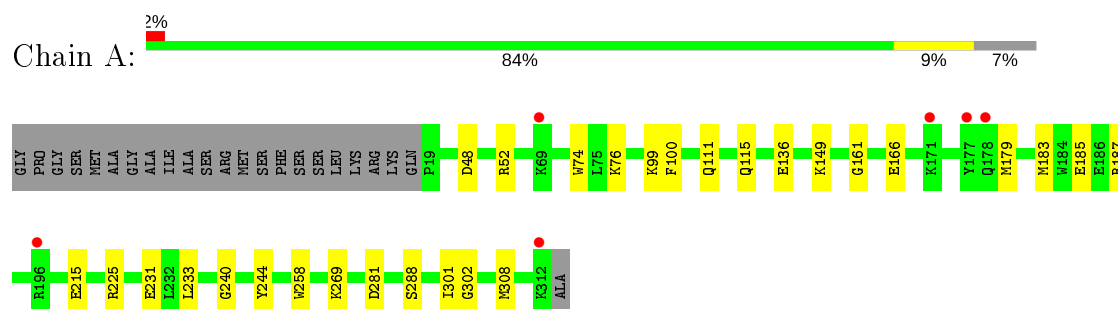
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	24	Total	O	0	0
			24	24		
4	B	7	Total	O	0	0
			7	7		

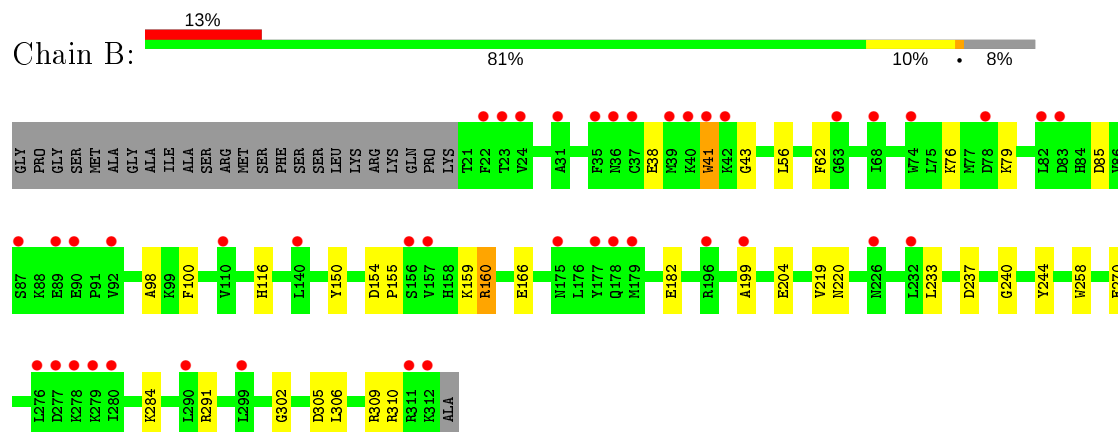
### 3 Residue-property plots [i](#)

These plots are drawn for all protein, RNA and DNA 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.

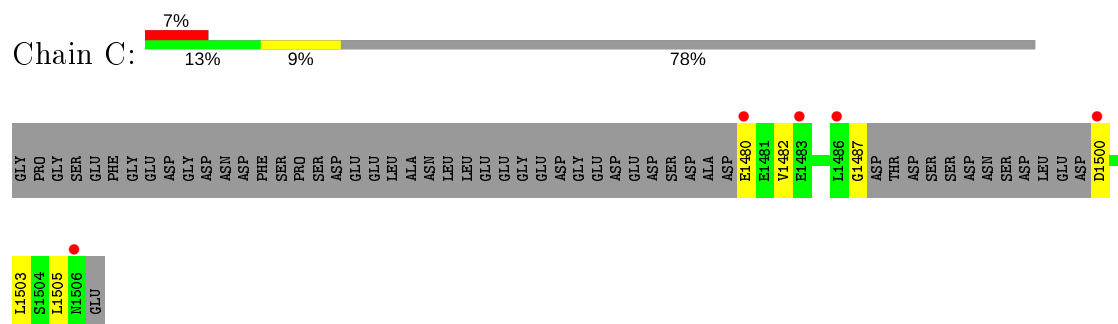
#### • Molecule 1: Merlin



#### • Molecule 1: Merlin



#### • Molecule 2: Protein VPRBP



#### • Molecule 2: Protein VPRBP



GLY	PRO	GLY	SER	GLU	PHE	GLY	GLU	ASP	GLY	ASP	ASN	ASP	PHE	SER	PRO	SER	SER	ASP	GLU	GLU	LEU	ALA	ASN	LEU	LEU	GLU	GLY	GLU	ASP	GLY	GLU	ASP	GLU	ASP	GLU	ASP	SER	SER	ASP	ALA	ASP	GLU	GLU	VAL	GLU	LEU	ILE	LEU	GLY	THR	ASP	SER	SER	ASN	SER	ASP	LEU	GLU	ASP	D1500
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I1501	I1502	L1503	S1504	L1505	N1506	GLU
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## 4 Data and refinement statistics

Property	Value	Source
Space group	P 31 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	97.10Å 97.10Å 224.34Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	31.47 – 2.60 31.47 – 2.60	Depositor EDS
% Data completeness (in resolution range)	97.9 (31.47-2.60) 88.0 (31.47-2.60)	Depositor EDS
$R_{merge}$	0.08	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.90 (at 2.61Å)	Xtriage
Refinement program	PHENIX (phenix.refine: 1.8.2_1309)	Depositor
R, $R_{free}$	0.224 , 0.256 0.224 , 0.256	Depositor DCC
$R_{free}$ test set	1888 reflections (4.99%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	64.8	Xtriage
Anisotropy	0.272	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.34 , 60.3	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.31$	Xtriage
Estimated twinning fraction	0.036 for -h,-k,l	Xtriage
$F_o, F_c$ correlation	0.93	EDS
Total number of atoms	5107	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	96.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 2.64% of the height of the origin peak. No significant pseudotranslation is detected.*

<sup>1</sup>Intensities estimated from amplitudes.

<sup>2</sup>Theoretical 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: GOL

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	0.27	0/2518	0.41	0/3396
1	B	0.23	0/2501	0.38	0/3374
2	C	0.22	0/114	0.45	0/152
2	D	0.20	0/53	0.41	0/71
All	All	0.25	0/5186	0.40	0/6993

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	2458	0	2464	15	0
1	B	2442	0	2443	19	0
2	C	116	0	120	4	0
2	D	54	0	58	1	0
3	A	6	0	8	0	0
4	A	24	0	0	0	0
4	B	7	0	0	2	0
All	All	5107	0	5093	37	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 4.

All (37) 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:155:PRO:O	1:B:159:LYS:NZ	2.13	0.81
1:A:149:LYS:NZ	1:A:166:GLU:OE2	2.13	0.81
1:A:74:TRP:O	1:A:76:LYS:NZ	2.14	0.80
1:A:233:LEU:HB2	1:A:244:TYR:HB2	1.72	0.71
1:B:85:ASP:OD2	1:B:291:ARG:NH1	2.31	0.64
2:C:1487:GLY:N	2:C:1500:ASP:O	2.32	0.58
1:B:116:HIS:ND1	1:B:204:GLU:OE2	2.38	0.57
1:A:179:MET:HB3	1:A:183:MET:HB2	1.88	0.56
1:A:161:GLY:N	1:A:185:GLU:OE2	2.35	0.55
2:C:1482:VAL:HG13	2:C:1505:LEU:HD23	1.90	0.54
1:B:150:TYR:OH	1:B:166:GLU:OE2	2.19	0.54
1:B:233:LEU:HB2	1:B:244:TYR:HB2	1.91	0.52
1:A:100:PHE:CZ	1:A:302:GLY:HA3	2.44	0.52
2:D:1500:ASP:OD1	2:D:1500:ASP:N	2.43	0.52
1:B:220:ASN:ND2	4:B:406:HOH:O	2.42	0.52
1:A:136:GLU:OE1	1:A:187:ARG:NH2	2.40	0.51
1:B:240:GLY:HA2	1:B:258:TRP:CE2	2.48	0.49
1:A:240:GLY:HA2	1:A:258:TRP:CE2	2.48	0.48
1:A:301:ILE:HG12	2:C:1503:LEU:HD11	1.95	0.48
1:B:270:GLU:OE2	1:B:284:LYS:HD3	2.14	0.48
1:A:48:ASP:O	1:A:52:ARG:HG3	2.15	0.47
1:B:98:ALA:O	4:B:401:HOH:O	2.20	0.47
1:A:225:ARG:NH2	1:A:231:GLU:OE1	2.43	0.46
1:A:269:LYS:HD3	1:A:288:SER:HA	1.98	0.45
1:A:74:TRP:CD1	1:A:99:LYS:HE3	2.51	0.45
1:A:308:MET:HB3	2:C:1480:GLU:HA	1.98	0.45
1:B:160:ARG:HG2	1:B:182:GLU:OE2	2.17	0.45
1:B:219:VAL:HG22	1:B:237:ASP:HB3	2.00	0.44
1:B:100:PHE:CZ	1:B:302:GLY:HA3	2.54	0.43
1:B:306:LEU:O	1:B:310:ARG:HG3	2.18	0.43
1:B:43:GLY:HA3	1:B:76:LYS:O	2.19	0.43
1:B:38:GLU:HB2	1:B:41:TRP:CG	2.54	0.42
1:B:79:LYS:HE3	1:B:79:LYS:HB2	1.85	0.42
1:B:305:ASP:OD2	1:B:309:ARG:NE	2.49	0.41
1:B:56:LEU:HD21	1:B:62:PHE:CD2	2.54	0.41
1:A:111:GLN:O	1:A:115:GLN:HG3	2.20	0.41
1:B:154:ASP:HA	1:B:155:PRO:HD3	1.92	0.41

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	292/317 (92%)	289 (99%)	3 (1%)	0	100	100
1	B	290/317 (92%)	278 (96%)	10 (3%)	2 (1%)	22	43
2	C	11/67 (16%)	11 (100%)	0	0	100	100
2	D	5/67 (8%)	5 (100%)	0	0	100	100
All	All	598/768 (78%)	583 (98%)	13 (2%)	2 (0%)	41	64

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	160	ARG
1	B	199	ALA

### 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	268/284 (94%)	266 (99%)	2 (1%)	84	94
1	B	266/284 (94%)	265 (100%)	1 (0%)	91	97
2	C	14/58 (24%)	14 (100%)	0	100	100
2	D	7/58 (12%)	7 (100%)	0	100	100
All	All	555/684 (81%)	552 (100%)	3 (0%)	88	96

All (3) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	215	GLU
1	A	281	ASP
1	B	41	TRP

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. There are no such sidechains identified.

### 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 carbohydrates in this entry.

## 5.6 Ligand geometry [i](#)

1 ligand is 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	$\# Z  > 2$
3	GOL	A	401	-	5,5,5	0.33	0	5,5,5	0.29	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
3	GOL	A	401	-	-	2/4/4/4	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (2) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
3	A	401	GOL	O1-C1-C2-C3
3	A	401	GOL	O1-C1-C2-O2

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

### 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, 95<sup>th</sup> 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 <sup>2</sup> )	Q<0.9
1	A	294/317 (92%)	0.09	6 (2%) 65 60	38, 64, 117, 149	0
1	B	292/317 (92%)	0.80	42 (14%) 2 1	75, 118, 155, 195	0
2	C	15/67 (22%)	1.32	5 (33%) 0 0	65, 96, 132, 138	0
2	D	7/67 (10%)	3.65	5 (71%) 0 0	122, 139, 152, 166	0
All	All	608/768 (79%)	0.50	58 (9%) 8 5	38, 96, 149, 195	0

All (58) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	178	GLN	9.9
2	D	1506	ASN	7.3
2	D	1502	ILE	7.1
2	C	1506	ASN	5.5
1	B	35	PHE	5.4
1	B	279	LYS	5.3
2	C	1480	GLU	5.2
1	B	278	LYS	4.2
1	B	177	TYR	4.1
1	B	82	LEU	3.9
2	D	1501	ILE	3.9
1	B	83	ASP	3.8
1	B	40	LYS	3.7
1	A	177	TYR	3.7
1	B	87	SER	3.6
1	B	175	ASN	3.5
1	B	24	VAL	3.5
1	B	78	ASP	3.4
1	A	196	ARG	3.3
1	B	92	VAL	3.3
2	C	1486	LEU	3.2

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Mol	Chain	Res	Type	RSRZ
1	B	39	MET	3.1
1	B	276	LEU	3.1
1	B	36	ASN	3.0
2	D	1500	ASP	3.0
1	B	156	SER	2.9
1	B	179	MET	2.9
1	B	312	LYS	2.9
1	B	68	ILE	2.8
1	B	290	LEU	2.8
1	B	42	LYS	2.8
1	B	232	LEU	2.8
1	B	280	ILE	2.7
1	B	90	GLU	2.7
1	A	69	LYS	2.6
1	B	37	CYS	2.6
1	B	89	GLU	2.6
1	B	110	VAL	2.6
1	A	178	GLN	2.6
1	B	31	ALA	2.5
1	B	157	VAL	2.5
1	B	226	ASN	2.5
2	D	1504	SER	2.5
1	B	41	TRP	2.4
1	A	312	LYS	2.4
1	B	199	ALA	2.4
1	B	23	THR	2.4
1	B	299	LEU	2.4
1	B	74	TRP	2.4
1	B	140	LEU	2.3
1	B	196	ARG	2.3
1	B	22	PHE	2.3
2	C	1500	ASP	2.3
1	B	277	ASP	2.2
1	B	63	GLY	2.1
1	B	311	ARG	2.1
2	C	1483	GLU	2.0
1	A	171	LYS	2.0

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

There are no non-standard protein/DNA/RNA residues in this entry.

### 6.3 Carbohydrates [i](#)

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. The B-factors column lists the minimum, median, 95<sup>th</sup> 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( $\text{\AA}^2$ )	Q<0.9
3	GOL	A	401	6/6	0.90	0.23	71,72,78,79	0

### 6.5 Other polymers [i](#)

There are no such residues in this entry.