



# Full wwPDB X-ray Structure Validation Report ⓘ

Dec 12, 2023 – 02:07 pm GMT

PDB ID : 4BG5  
Title : Lyme disease associated outer surface protein BBA65 from *Borrelia burgdorferi*  
Authors : Brangulis, K.; Petrovskis, I.; Kazaks, A.; Tars, K.  
Deposited on : 2013-03-22  
Resolution : 3.40 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.

The types of validation reports are described at

<http://www.wwpdb.org/validation/2017/FAQs#types>.

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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  
Xtriage (Phenix) : 1.13  
EDS : 2.36  
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) : 2.36

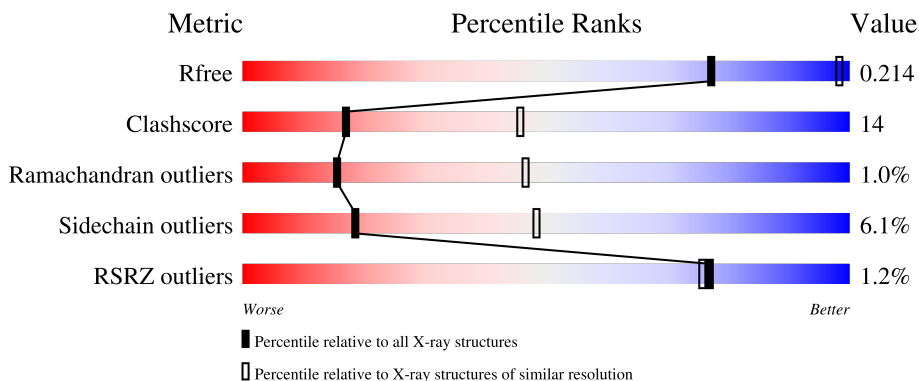
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 3.40 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	1026 (3.48-3.32)
Clashscore	141614	1055 (3.48-3.32)
Ramachandran outliers	138981	1038 (3.48-3.32)
Sidechain outliers	138945	1038 (3.48-3.32)
RSRZ outliers	127900	2173 (3.50-3.30)

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  $\geq 3$ , 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	262	
1	B	262	

## 2 Entry composition

There is only 1 type of molecule in this entry. The entry contains 3271 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 BBA65.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	201	1644	1051	267	319	7	0	0	0
1	B	199	1627	1039	264	317	7	0	0	0

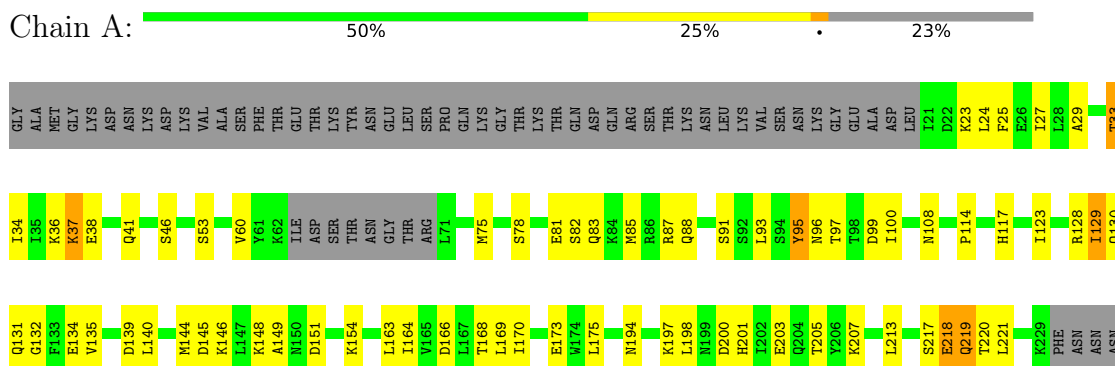
There are 8 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-28	GLY	-	expression tag	UNP O50954
A	-27	ALA	-	expression tag	UNP O50954
A	-26	MET	-	expression tag	UNP O50954
A	-25	GLY	-	expression tag	UNP O50954
B	-28	GLY	-	expression tag	UNP O50954
B	-27	ALA	-	expression tag	UNP O50954
B	-26	MET	-	expression tag	UNP O50954
B	-25	GLY	-	expression tag	UNP O50954

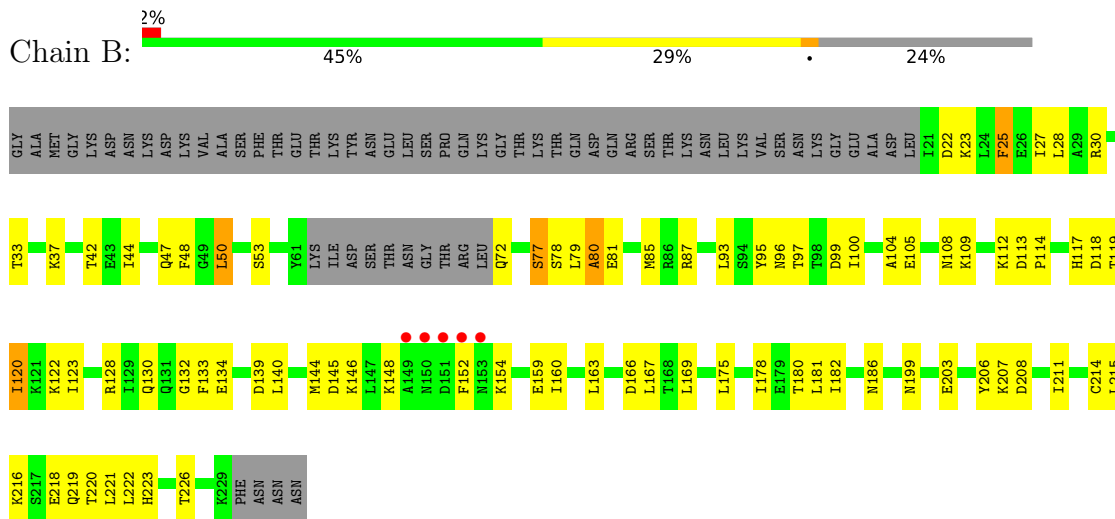
### 3 Residue-property plots [i](#)

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: BBA65



- Molecule 1: BBA65



## 4 Data and refinement statistics

Property	Value	Source
Space group	C 1 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	136.81Å 69.87Å 58.88Å 90.00° 101.45° 90.00°	Depositor
Resolution (Å)	48.79 – 3.40 48.79 – 3.40	Depositor EDS
% Data completeness (in resolution range)	95.6 (48.79-3.40) 95.7 (48.79-3.40)	Depositor EDS
$R_{merge}$	0.18	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	7.51 (at 3.40Å)	Xtrriage
Refinement program	REFMAC 5.7.0032	Depositor
R, $R_{free}$	0.165 , 0.229 0.161 , 0.214	Depositor DCC
$R_{free}$ test set	346 reflections (4.74%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	38.2	Xtrriage
Anisotropy	0.135	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.34 , 34.0	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.45$ , $\langle L^2 \rangle = 0.28$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.93	EDS
Total number of atoms	3271	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	31.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 6.10% 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](#)

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	1/1664 (0.1%)	0.86	3/2234 (0.1%)
1	B	0.68	2/1647 (0.1%)	0.86	6/2212 (0.3%)
All	All	0.65	3/3311 (0.1%)	0.86	9/4446 (0.2%)

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	77	SER	C-N	11.88	1.61	1.34
1	A	218	GLU	C-N	-9.61	1.11	1.34
1	B	80	ALA	C-N	-8.56	1.14	1.34

All (9) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	77	SER	O-C-N	11.71	141.44	122.70
1	A	218	GLU	O-C-N	10.98	140.26	122.70
1	A	218	GLU	C-N-CA	-10.67	95.02	121.70
1	B	77	SER	CA-C-N	-9.24	96.88	117.20
1	A	218	GLU	CA-C-N	-8.94	97.53	117.20
1	B	77	SER	C-N-CA	-8.55	100.32	121.70
1	B	80	ALA	O-C-N	-8.25	109.50	122.70
1	B	80	ALA	CA-C-N	5.35	128.96	117.20
1	B	80	ALA	C-N-CA	5.33	135.03	121.70

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	1644	0	1695	46	0
1	B	1627	0	1670	55	0
All	All	3271	0	3365	93	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 14.

All (93) 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:25:PHE:HB3	1:B:145:ASP:HB3	1.17	1.17
1:A:29:ALA:O	1:A:33:THR:HG22	1.74	0.86
1:A:53:SER:OG	1:A:108:ASN:ND2	2.09	0.86
1:A:25:PHE:HB3	1:B:145:ASP:CB	2.05	0.83
1:A:131:GLN:O	1:A:135:VAL:HG23	1.79	0.82
1:A:25:PHE:CB	1:B:145:ASP:HB3	2.09	0.76
1:B:30:ARG:O	1:B:33:THR:HG22	1.85	0.76
1:A:23:LYS:O	1:A:27:ILE:HG13	1.91	0.70
1:B:109:LYS:HA	1:B:112:LYS:HE2	1.75	0.68
1:B:81:GLU:OE1	1:B:81:GLU:N	2.27	0.66
1:A:41:GLN:HG2	1:A:95:TYR:CE1	2.33	0.63
1:A:81:GLU:OE1	1:A:81:GLU:N	2.27	0.62
1:A:25:PHE:CE2	1:B:148:LYS:HG3	2.36	0.61
1:B:122:LYS:HG3	1:B:207:LYS:HE3	1.84	0.59
1:B:28:LEU:HD13	1:B:140:LEU:HD23	1.83	0.59
1:A:87:ARG:NH2	1:A:134:GLU:OE2	2.26	0.58
1:B:218:GLU:O	1:B:222:LEU:HD13	2.03	0.58
1:B:97:THR:HA	1:B:100:ILE:HD12	1.84	0.58
1:A:60:VAL:HG11	1:A:82:SER:HB3	1.86	0.58
1:B:77:SER:HB2	1:B:79:LEU:H	1.69	0.57
1:B:145:ASP:OD1	1:B:146:LYS:N	2.37	0.57
1:B:93:LEU:HA	1:B:175:LEU:HD13	1.85	0.57
1:B:118:ASP:OD2	1:B:122:LYS:NZ	2.38	0.56
1:A:78:SER:HB3	1:B:78:SER:HB3	1.86	0.56
1:A:217:SER:O	1:A:221:LEU:HD13	2.07	0.55
1:A:198:LEU:O	1:A:201:HIS:HB3	2.06	0.55
1:A:128:ARG:O	1:A:129:ILE:C	2.45	0.55
1:B:53:SER:OG	1:B:108:ASN:ND2	2.41	0.54
1:A:114:PRO:HA	1:A:117:HIS:CD2	2.42	0.53

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:181:LEU:HA	1:B:206:TYR:CE2	2.43	0.53
1:A:24:LEU:HD23	1:A:27:ILE:HD12	1.91	0.52
1:A:149:ALA:C	1:A:151:ASP:H	2.12	0.52
1:B:50:LEU:HD13	1:B:104:ALA:HB2	1.92	0.51
1:A:145:ASP:O	1:A:148:LYS:HB2	2.10	0.51
1:B:87:ARG:NH2	1:B:134:GLU:OE2	2.44	0.51
1:B:220:THR:O	1:B:223:HIS:HB3	2.11	0.51
1:B:25:PHE:CZ	1:B:144:MET:HG2	2.46	0.50
1:A:36:LYS:NZ	1:B:139:ASP:OD1	2.45	0.49
1:B:80:ALA:O	1:B:81:GLU:C	2.47	0.49
1:B:199:ASN:ND2	1:B:203:GLU:OE2	2.44	0.49
1:A:145:ASP:OD1	1:A:146:LYS:N	2.45	0.49
1:A:194:ASN:ND2	1:A:197:LYS:HB2	2.28	0.49
1:B:128:ARG:HD2	1:B:214:CYS:SG	2.53	0.49
1:B:181:LEU:HA	1:B:206:TYR:CZ	2.47	0.49
1:A:93:LEU:HA	1:A:175:LEU:HD13	1.94	0.48
1:A:139:ASP:O	1:A:140:LEU:C	2.50	0.48
1:B:178:ILE:HG22	1:B:182:ILE:HD11	1.95	0.48
1:A:75:MET:O	1:A:75:MET:HG2	2.14	0.48
1:A:37:LYS:HE2	1:A:38:GLU:HG3	1.96	0.48
1:B:180:THR:O	1:B:181:LEU:C	2.51	0.47
1:A:96:ASN:HD22	1:A:99:ASP:CG	2.17	0.47
1:A:170:ILE:HG23	1:A:213:LEU:HD22	1.94	0.47
1:B:113:ASP:OD1	1:B:113:ASP:C	2.52	0.47
1:A:25:PHE:HE1	1:A:144:MET:HG2	1.78	0.47
1:A:82:SER:O	1:A:85:MET:N	2.48	0.47
1:B:120:ILE:O	1:B:123:ILE:N	2.49	0.46
1:A:163:LEU:HD22	1:A:220:THR:HG23	1.98	0.46
1:B:166:ASP:O	1:B:169:LEU:N	2.49	0.46
1:A:164:ILE:O	1:A:168:THR:HG23	2.16	0.46
1:B:117:HIS:O	1:B:118:ASP:C	2.54	0.45
1:B:215:LEU:O	1:B:216:LYS:C	2.54	0.45
1:B:166:ASP:N	1:B:166:ASP:OD1	2.49	0.45
1:A:25:PHE:CD2	1:B:148:LYS:HG3	2.52	0.45
1:A:88:GLN:HG2	1:A:134:GLU:OE2	2.16	0.45
1:B:163:LEU:HD11	1:B:223:HIS:CD2	2.52	0.45
1:B:166:ASP:O	1:B:167:LEU:C	2.55	0.45
1:A:37:LYS:HG2	1:A:38:GLU:N	2.31	0.44
1:A:169:LEU:O	1:A:170:ILE:C	2.56	0.44
1:B:23:LYS:O	1:B:27:ILE:HG13	2.18	0.44
1:B:148:LYS:HE2	1:B:148:LYS:HA	1.98	0.44

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:208:ASP:HA	1:B:211:ILE:HD12	2.00	0.44
1:A:203:GLU:HA	1:A:207:LYS:HB2	2.00	0.44
1:B:132:GLY:HA2	1:B:221:LEU:HD21	2.00	0.44
1:A:83:GLN:NE2	1:B:80:ALA:HB2	2.33	0.43
1:B:104:ALA:O	1:B:105:GLU:C	2.56	0.43
1:A:130:GLN:O	1:A:131:GLN:C	2.58	0.43
1:A:132:GLY:HA2	1:A:221:LEU:HD21	2.00	0.42
1:B:223:HIS:O	1:B:226:THR:HB	2.19	0.42
1:A:25:PHE:HE1	1:A:144:MET:CG	2.33	0.42
1:A:123:ILE:O	1:A:123:ILE:HG22	2.19	0.42
1:B:114:PRO:O	1:B:117:HIS:HB2	2.20	0.42
1:B:130:GLN:O	1:B:133:PHE:HB3	2.19	0.42
1:A:218:GLU:O	1:A:219:GLN:C	2.55	0.41
1:B:159:GLU:O	1:B:163:LEU:HG	2.20	0.41
1:B:96:ASN:HB3	1:B:99:ASP:HB2	2.03	0.41
1:B:119:THR:O	1:B:120:ILE:C	2.58	0.41
1:B:50:LEU:CD1	1:B:104:ALA:HA	2.51	0.41
1:B:44:ILE:O	1:B:47:GLN:N	2.45	0.40
1:B:207:LYS:O	1:B:211:ILE:HG13	2.20	0.40
1:A:97:THR:HA	1:A:100:ILE:HD12	2.03	0.40
1:B:44:ILE:HD11	1:B:48:PHE:HA	2.04	0.40
1:A:217:SER:O	1:A:221:LEU:CD1	2.70	0.40
1:B:50:LEU:HD13	1:B:104:ALA:CB	2.52	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	197/262 (75%)	180 (91%)	15 (8%)	2 (1%)	15 46
1	B	195/262 (74%)	175 (90%)	18 (9%)	2 (1%)	15 46

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
All	All	392/524 (75%)	355 (91%)	33 (8%)	4 (1%)	15	46

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	120	ILE
1	A	34	ILE
1	A	129	ILE
1	B	160	ILE

### 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	189/242 (78%)	178 (94%)	11 (6%)	20	50
1	B	187/242 (77%)	175 (94%)	12 (6%)	17	47
All	All	376/484 (78%)	353 (94%)	23 (6%)	18	48

All (23) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	33	THR
1	A	37	LYS
1	A	46	SER
1	A	91	SER
1	A	95	TYR
1	A	154	LYS
1	A	166	ASP
1	A	173	GLU
1	A	200	ASP
1	A	205	THR
1	A	219	GLN
1	B	22	ASP
1	B	25	PHE
1	B	37	LYS

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Mol	Chain	Res	Type
1	B	42	THR
1	B	50	LEU
1	B	72	GLN
1	B	85	MET
1	B	95	TYR
1	B	152	PHE
1	B	154	LYS
1	B	186	ASN
1	B	219	GLN

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (10) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	83	GLN
1	A	108	ASN
1	A	117	HIS
1	A	223	HIS
1	B	47	GLN
1	B	72	GLN
1	B	108	ASN
1	B	131	GLN
1	B	186	ASN
1	B	223	HIS

### 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](#)

The following chains have linkage breaks:

Mol	Chain	Number of breaks
1	B	2
1	A	1

All chain breaks are listed below:

Model	Chain	Residue-1	Atom-1	Residue-2	Atom-2	Distance (Å)
1	B	77:SER	C	78:SER	N	1.61
1	B	80:ALA	C	81:GLU	N	1.14
1	A	218:GLU	C	219:GLN	N	1.11

## 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, 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	201/262 (76%)	-0.39	0 <a href="#">100</a> <a href="#">100</a>	14, 28, 49, 72	0
1	B	199/262 (75%)	-0.39	5 (2%) <a href="#">57</a> <a href="#">55</a>	18, 27, 53, 101	0
All	All	400/524 (76%)	-0.39	5 (1%) <a href="#">77</a> <a href="#">76</a>	14, 28, 52, 101	0

All (5) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	151	ASP	5.1
1	B	152	PHE	3.5
1	B	150	ASN	2.9
1	B	149	ALA	2.3
1	B	153	ASN	2.1

### 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.