



# Full wwPDB X-ray Structure Validation Report ⓘ

Mar 8, 2026 – 08:10 AM UTC

PDB ID : 5JEC / pdb\_00005jec  
Title : Apo-structure of humanised RadA-mutant humRadA33F  
Authors : Fischer, G.; Marsh, M.; Moschetti, T.; Sharpe, T.; Scott, D.; Morgan, M.; Ng, H.; Skidmore, J.; Venkitaraman, A.; Abell, C.; Blundell, T.L.; Hyvonen, M.  
Deposited on : 2016-04-18  
Resolution : 2.34 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 : 4-5-2 with Phenix2.0  
Mogul : 2022.3.0, CSD as543be (2022)  
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

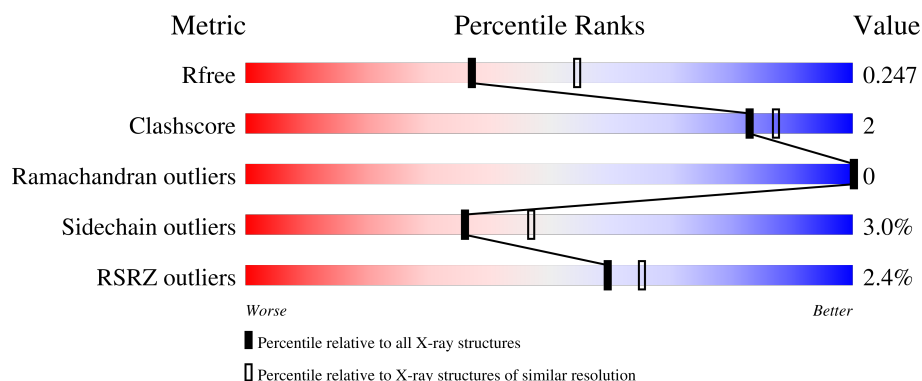
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

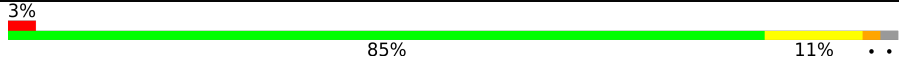
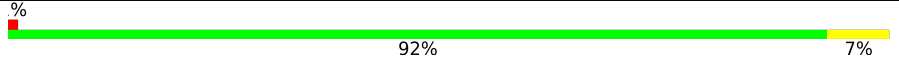
The reported resolution of this entry is 2.34 Å.

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	3031 (2.36-2.32)
Clashscore	190562	3127 (2.36-2.32)
Ramachandran outliers	187476	3095 (2.36-2.32)
Sidechain outliers	187428	3095 (2.36-2.32)
RSRZ outliers	180081	3033 (2.36-2.32)

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	231	
1	B	231	

## 2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 3579 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 repair and recombination protein RadA.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	226	Total	C	N	O	S	0	0	0
			1738	1092	315	326	5			
1	B	230	Total	C	N	O	S	0	0	0
			1740	1092	314	329	5			

There are 70 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	107	MET	-	initiating methionine	UNP O74036
A	167	LYS	SER	engineered mutation	UNP O74036
A	168	ALA	VAL	engineered mutation	UNP O74036
A	169	MET	ILE	engineered mutation	UNP O74036
A	170	TYR	TRP	engineered mutation	UNP O74036
A	175	GLY	ASN	engineered mutation	UNP O74036
A	182	LEU	ILE	engineered mutation	UNP O74036
A	183	LEU	ARG	engineered mutation	UNP O74036
A	192	SER	ASP	engineered mutation	UNP O74036
A	193	GLY	PRO	engineered mutation	UNP O74036
A	194	SER	ASP	engineered mutation	UNP O74036
A	195	ASP	GLU	engineered mutation	UNP O74036
A	198	ASP	LYS	engineered mutation	UNP O74036
A	199	ASN	HIS	engineered mutation	UNP O74036
A	200	VAL	ILE	engineered mutation	UNP O74036
A	201	ALA	TYR	engineered mutation	UNP O74036
A	202	TYR	VAL	engineered mutation	UNP O74036
A	219	SER	GLU	engineered mutation	UNP O74036
A	221	MET	LYS	engineered mutation	UNP O74036
A	222	MET	ILE	engineered mutation	UNP O74036
A	223	VAL	LYS	engineered mutation	UNP O74036
A	232	TYR	VAL	engineered mutation	UNP O74036
A	?	-	ARG	deletion	UNP O74036
A	?	-	PRO	deletion	UNP O74036
A	?	-	ASP	deletion	UNP O74036

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Chain	Residue	Modelled	Actual	Comment	Reference
A	?	-	ALA	deletion	UNP O74036
A	?	-	PHE	deletion	UNP O74036
A	?	-	PHE	deletion	UNP O74036
A	?	-	GLY	deletion	UNP O74036
A	?	-	ASP	deletion	UNP O74036
A	?	-	PRO	deletion	UNP O74036
A	?	-	THR	deletion	UNP O74036
A	?	-	ARG	deletion	UNP O74036
A	?	-	PRO	deletion	UNP O74036
A	288	ASN	ILE	engineered mutation	UNP O74036
B	107	MET	-	initiating methionine	UNP O74036
B	167	LYS	SER	engineered mutation	UNP O74036
B	168	ALA	VAL	engineered mutation	UNP O74036
B	169	MET	ILE	engineered mutation	UNP O74036
B	170	TYR	TRP	engineered mutation	UNP O74036
B	175	GLY	ASN	engineered mutation	UNP O74036
B	182	LEU	ILE	engineered mutation	UNP O74036
B	183	LEU	ARG	engineered mutation	UNP O74036
B	192	SER	ASP	engineered mutation	UNP O74036
B	193	GLY	PRO	engineered mutation	UNP O74036
B	194	SER	ASP	engineered mutation	UNP O74036
B	195	ASP	GLU	engineered mutation	UNP O74036
B	198	ASP	LYS	engineered mutation	UNP O74036
B	199	ASN	HIS	engineered mutation	UNP O74036
B	200	VAL	ILE	engineered mutation	UNP O74036
B	201	ALA	TYR	engineered mutation	UNP O74036
B	202	TYR	VAL	engineered mutation	UNP O74036
B	219	SER	GLU	engineered mutation	UNP O74036
B	221	MET	LYS	engineered mutation	UNP O74036
B	222	MET	ILE	engineered mutation	UNP O74036
B	223	VAL	LYS	engineered mutation	UNP O74036
B	232	TYR	VAL	engineered mutation	UNP O74036
B	?	-	ARG	deletion	UNP O74036
B	?	-	PRO	deletion	UNP O74036
B	?	-	ASP	deletion	UNP O74036
B	?	-	ALA	deletion	UNP O74036
B	?	-	PHE	deletion	UNP O74036
B	?	-	PHE	deletion	UNP O74036
B	?	-	GLY	deletion	UNP O74036
B	?	-	ASP	deletion	UNP O74036
B	?	-	PRO	deletion	UNP O74036
B	?	-	THR	deletion	UNP O74036

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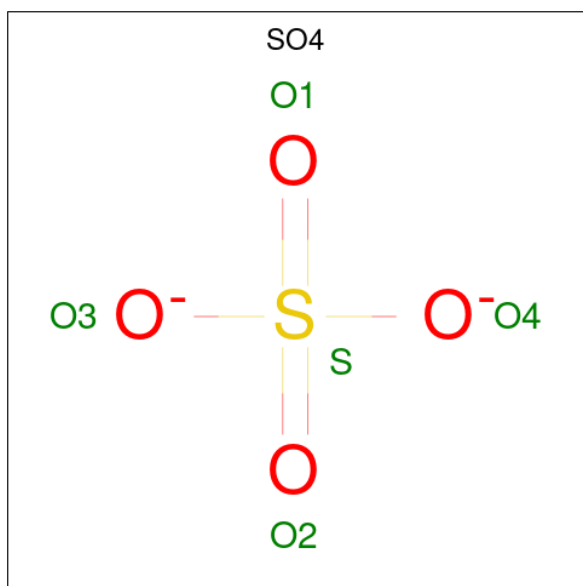
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Chain	Residue	Modelled	Actual	Comment	Reference
B	?	-	ARG	deletion	UNP O74036
B	?	-	PRO	deletion	UNP O74036
B	288	ASN	ILE	engineered mutation	UNP O74036

- Molecule 2 is CHLORIDE ION (CCD ID: CL) (formula: Cl).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
2	A	2	Total Cl 2 2	0	0

- Molecule 3 is SULFATE ION (CCD ID: SO4) (formula: O<sub>4</sub>S).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	1	Total O S 5 4 1	0	0
3	B	1	Total O S 5 4 1	0	0

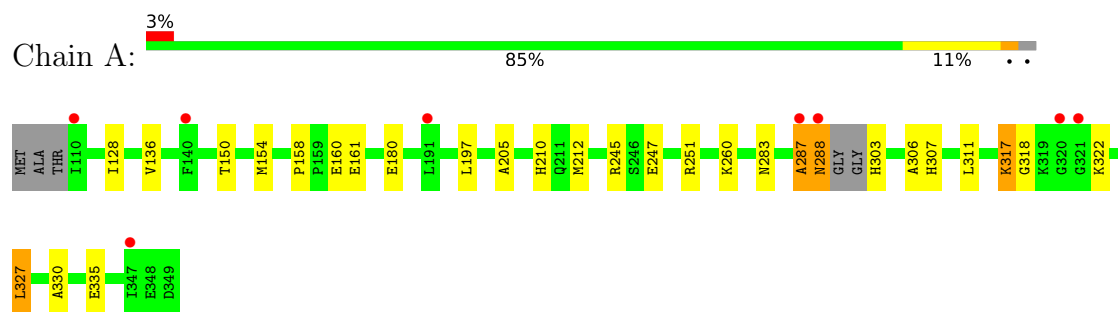
- Molecule 4 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	42	Total O 42 42	0	0
4	B	47	Total O 47 47	0	0

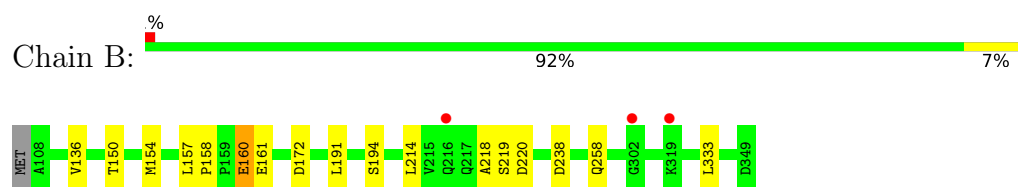
### 3 Residue-property plots

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: DNA repair and recombination protein RadA



- Molecule 1: DNA repair and recombination protein RadA



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 31 2 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	90.75Å 90.75Å 102.51Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	78.59 – 2.34 78.59 – 2.34	Depositor EDS
% Data completeness (in resolution range)	99.9 (78.59-2.34) 99.9 (78.59-2.34)	Depositor EDS
$R_{merge}$	0.19	Depositor
$R_{sym}$	0.21	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.93 (at 2.34Å)	Xtriage
Refinement program	BUSTER 2.10.2	Depositor
R, $R_{free}$	0.199 , 0.239 0.205 , 0.247	Depositor DCC
$R_{free}$ test set	1079 reflections (5.13%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	35.2	Xtriage
Anisotropy	0.171	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.34 , 35.5	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.32$	Xtriage
Estimated twinning fraction	0.034 for -h,-k,l	Xtriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	3579	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	39.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.69% 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

### 5.1 Standard geometry

Bond lengths and bond angles in the following residue types are not validated in this section: SO4, CL

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	0.80	0/1763	1.37	4/2375 (0.2%)
1	B	0.86	2/1766 (0.1%)	1.38	10/2385 (0.4%)
All	All	0.83	2/3529 (0.1%)	1.37	14/4760 (0.3%)

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	B	220	ASP	C-N	-5.52	1.25	1.33
1	B	194	SER	C-N	5.12	1.40	1.33

All (14) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	B	219	SER	CA-C-N	5.99	128.31	120.28
1	B	219	SER	C-N-CA	5.99	128.31	120.28
1	B	136	VAL	N-CA-CB	5.66	118.95	111.25
1	B	258	GLN	CA-C-N	5.62	128.08	120.44
1	B	258	GLN	C-N-CA	5.62	128.08	120.44
1	A	247	GLU	N-CA-C	5.51	118.47	111.69
1	B	218	ALA	CA-C-N	5.37	127.78	120.54
1	B	218	ALA	C-N-CA	5.37	127.78	120.54
1	B	238	ASP	CA-C-N	5.22	131.09	121.70
1	B	238	ASP	C-N-CA	5.22	131.09	121.70
1	A	136	VAL	N-CA-CB	5.17	118.27	111.25
1	A	287	ALA	CA-C-N	5.15	130.96	121.70
1	A	287	ALA	C-N-CA	5.15	130.96	121.70
1	B	172	ASP	CA-CB-CG	5.04	117.64	112.60

There are no chirality outliers.

There are no planarity outliers.



## 5.2 Too-close contacts ⓘ

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	1738	0	1760	13	0
1	B	1740	0	1742	5	0
2	A	2	0	0	0	0
3	A	5	0	0	0	0
3	B	5	0	0	0	0
4	A	42	0	0	1	0
4	B	47	0	0	0	0
All	All	3579	0	3502	17	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 2.

All (17) 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:160:GLU:HG2	1:B:161:GLU:OE1	1.91	0.71
1:A:327:LEU:HG	1:A:330:ALA:HB2	1.86	0.57
1:A:318:GLY:HA3	1:A:322:LYS:O	2.04	0.56
1:A:318:GLY:CA	1:A:322:LYS:O	2.60	0.49
1:B:158:PRO:HD2	1:B:161:GLU:HB2	1.97	0.46
1:A:158:PRO:HD2	1:A:161:GLU:HB2	1.97	0.46
1:A:205:ALA:HA	1:A:210:HIS:CD2	2.51	0.46
1:A:306:ALA:HB2	1:B:214:LEU:HD23	2.00	0.44
1:A:212:MET:HE1	1:A:260:LYS:HD2	2.00	0.44
1:A:283:ASN:ND2	1:A:307:HIS:HE1	2.15	0.44
1:A:245:ARG:HE	1:A:303:HIS:HB2	1.84	0.43
1:B:150:THR:O	1:B:154:MET:HG2	2.19	0.43
1:B:157:LEU:HD21	1:B:191:LEU:HD11	2.00	0.42
1:A:317:LYS:HA	1:A:318:GLY:HA3	1.83	0.42
1:A:287:ALA:O	1:A:288:ASN:HB3	2.19	0.42
1:A:128:ILE:HA	4:A:525:HOH:O	2.19	0.42
1:A:150:THR:O	1:A:154:MET:HG2	2.19	0.42

There are no symmetry-related clashes.

## 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	222/231 (96%)	220 (99%)	2 (1%)	0	100	100
1	B	228/231 (99%)	225 (99%)	3 (1%)	0	100	100
All	All	450/462 (97%)	445 (99%)	5 (1%)	0	100	100

There are no Ramachandran outliers to report.

### 5.3.2 Protein sidechains

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	182/186 (98%)	173 (95%)	9 (5%)	22	28
1	B	179/186 (96%)	177 (99%)	2 (1%)	65	77
All	All	361/372 (97%)	350 (97%)	11 (3%)	36	47

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

Mol	Chain	Res	Type
1	A	160	GLU
1	A	180	GLU
1	A	197	LEU
1	A	251	ARG
1	A	288	ASN
1	A	311	LEU
1	A	317	LYS
1	A	327	LEU

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Mol	Chain	Res	Type
1	A	335	GLU
1	B	160	GLU
1	B	333	LEU

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (6) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	187	GLN
1	A	210	HIS
1	A	273	ASN
1	A	283	ASN
1	B	273	ASN
1	B	332	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 oligosaccharides in this entry.

## 5.6 Ligand geometry [i](#)

Of 4 ligands modelled in this entry, 2 are monoatomic - leaving 2 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	$\# Z  > 2$
3	SO4	A	403	-	4,4,4	0.17	0	6,6,6	0.51	0
3	SO4	B	401	-	4,4,4	0.29	0	6,6,6	0.14	0

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, 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	226/231 (97%)	0.38	8 (3%) 47 53	22, 40, 69, 102	0
1	B	230/231 (99%)	0.07	3 (1%) 75 79	23, 35, 56, 74	0
All	All	456/462 (98%)	0.22	11 (2%) 59 65	22, 37, 64, 102	0

All (11) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	110	ILE	3.8
1	A	288	ASN	3.6
1	B	302	GLY	2.8
1	A	287	ALA	2.8
1	B	216	GLN	2.6
1	A	191	LEU	2.5
1	A	321	GLY	2.3
1	B	319	LYS	2.3
1	A	320	GLY	2.2
1	A	140	PHE	2.0
1	A	347	ILE	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 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, 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(Å <sup>2</sup> )	Q<0.9
2	CL	A	401	1/1	0.88	0.14	82,82,82,82	0
3	SO4	A	403	5/5	0.96	0.07	47,47,47,52	0
2	CL	A	402	1/1	0.99	0.05	28,28,28,28	0
3	SO4	B	401	5/5	0.99	0.05	33,33,36,37	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.