



# wwPDB X-ray Structure Validation Summary Report ⓘ

May 26, 2020 – 09:37 am BST

PDB ID : 5SYO  
Title : Crystal structure of a chimeric acetylcholine binding protein from *Aplysia californica* (Ac-AChBP) containing loop C from the human alpha 3 nicotinic acetylcholine receptor in complex with Cytisine  
Authors : Bobango, J.; Wu, J.; Talley, I.T.; Talley, T.T.  
Deposited on : 2016-08-11  
Resolution : 2.00 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](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

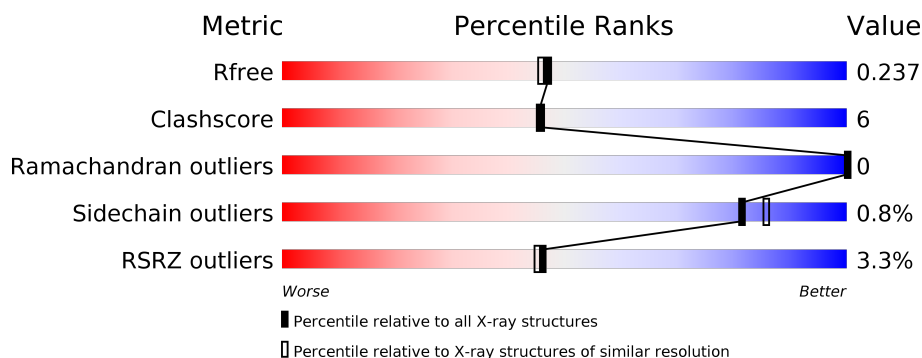
# 1 Overall quality at a glance ⓘ

The following experimental techniques were used to determine the structure:

## *X-RAY DIFFRACTION*

The reported resolution of this entry is 2.00 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	8085 (2.00-2.00)
Clashscore	141614	9178 (2.00-2.00)
Ramachandran outliers	138981	9054 (2.00-2.00)
Sidechain outliers	138945	9053 (2.00-2.00)
RSRZ outliers	127900	7900 (2.00-2.00)

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	230	<div> <div>2%</div> <div>80% 7% 13%</div> </div>
1	B	230	<div> <div>4%</div> <div>78% 9% 13%</div> </div>
1	C	230	<div> <div>4%</div> <div>73% 13% 12%</div> </div>
1	D	230	<div> <div>2%</div> <div>75% 12% 13%</div> </div>
1	E	230	<div> <div>3%</div> <div>79% 10% 11%</div> </div>

## 2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 8234 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 Soluble acetylcholine receptor, Neuronal acetylcholine receptor subunit alpha-3 chimera.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	199	Total	C	N	O	S	0	3	0
			1577	1009	252	310	6			
1	B	200	Total	C	N	O	S	0	3	0
			1565	1004	245	309	7			
1	C	202	Total	C	N	O	S	0	2	0
			1588	1012	253	315	8			
1	D	201	Total	C	N	O	S	0	0	0
			1565	998	247	312	8			
1	E	205	Total	C	N	O	S	0	1	0
			1602	1020	257	317	8			

There are 65 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-8	ASP	-	expression tag	UNP Q8WSF8
A	-7	TYR	-	expression tag	UNP Q8WSF8
A	-6	LYS	-	expression tag	UNP Q8WSF8
A	-5	ASP	-	expression tag	UNP Q8WSF8
A	-4	ASP	-	expression tag	UNP Q8WSF8
A	-3	ASP	-	expression tag	UNP Q8WSF8
A	-2	ASP	-	expression tag	UNP Q8WSF8
A	-1	LYS	-	expression tag	UNP Q8WSF8
A	0	LEU	-	expression tag	UNP Q8WSF8
A	55	TRP	TYR	engineered mutation	UNP Q8WSF8
A	199	VAL	ASN	engineered mutation	UNP Q8WSF8
A	220	SER	-	expression tag	UNP Q8WSF8
A	221	ARG	-	expression tag	UNP Q8WSF8
B	-8	ASP	-	expression tag	UNP Q8WSF8
B	-7	TYR	-	expression tag	UNP Q8WSF8
B	-6	LYS	-	expression tag	UNP Q8WSF8
B	-5	ASP	-	expression tag	UNP Q8WSF8
B	-4	ASP	-	expression tag	UNP Q8WSF8

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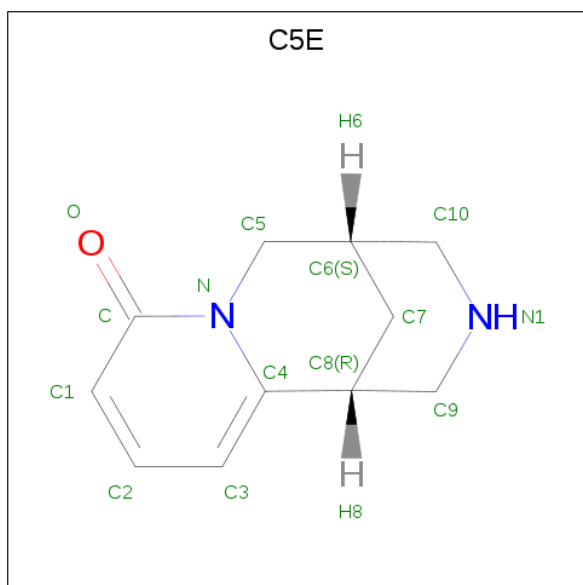
Chain	Residue	Modelled	Actual	Comment	Reference
B	-3	ASP	-	expression tag	UNP Q8WSF8
B	-2	ASP	-	expression tag	UNP Q8WSF8
B	-1	LYS	-	expression tag	UNP Q8WSF8
B	0	LEU	-	expression tag	UNP Q8WSF8
B	55	TRP	TYR	engineered mutation	UNP Q8WSF8
B	199	VAL	ASN	engineered mutation	UNP Q8WSF8
B	220	SER	-	expression tag	UNP Q8WSF8
B	221	ARG	-	expression tag	UNP Q8WSF8
C	-8	ASP	-	expression tag	UNP Q8WSF8
C	-7	TYR	-	expression tag	UNP Q8WSF8
C	-6	LYS	-	expression tag	UNP Q8WSF8
C	-5	ASP	-	expression tag	UNP Q8WSF8
C	-4	ASP	-	expression tag	UNP Q8WSF8
C	-3	ASP	-	expression tag	UNP Q8WSF8
C	-2	ASP	-	expression tag	UNP Q8WSF8
C	-1	LYS	-	expression tag	UNP Q8WSF8
C	0	LEU	-	expression tag	UNP Q8WSF8
C	55	TRP	TYR	engineered mutation	UNP Q8WSF8
C	199	VAL	ASN	engineered mutation	UNP Q8WSF8
C	220	SER	-	expression tag	UNP Q8WSF8
C	221	ARG	-	expression tag	UNP Q8WSF8
D	-8	ASP	-	expression tag	UNP Q8WSF8
D	-7	TYR	-	expression tag	UNP Q8WSF8
D	-6	LYS	-	expression tag	UNP Q8WSF8
D	-5	ASP	-	expression tag	UNP Q8WSF8
D	-4	ASP	-	expression tag	UNP Q8WSF8
D	-3	ASP	-	expression tag	UNP Q8WSF8
D	-2	ASP	-	expression tag	UNP Q8WSF8
D	-1	LYS	-	expression tag	UNP Q8WSF8
D	0	LEU	-	expression tag	UNP Q8WSF8
D	55	TRP	TYR	engineered mutation	UNP Q8WSF8
D	199	VAL	ASN	engineered mutation	UNP Q8WSF8
D	220	SER	-	expression tag	UNP Q8WSF8
D	221	ARG	-	expression tag	UNP Q8WSF8
E	-8	ASP	-	expression tag	UNP Q8WSF8
E	-7	TYR	-	expression tag	UNP Q8WSF8
E	-6	LYS	-	expression tag	UNP Q8WSF8
E	-5	ASP	-	expression tag	UNP Q8WSF8
E	-4	ASP	-	expression tag	UNP Q8WSF8
E	-3	ASP	-	expression tag	UNP Q8WSF8
E	-2	ASP	-	expression tag	UNP Q8WSF8
E	-1	LYS	-	expression tag	UNP Q8WSF8

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Chain	Residue	Modelled	Actual	Comment	Reference
E	0	LEU	-	expression tag	UNP Q8WSF8
E	55	TRP	TYR	engineered mutation	UNP Q8WSF8
E	199	VAL	ASN	engineered mutation	UNP Q8WSF8
E	220	SER	-	expression tag	UNP Q8WSF8
E	221	ARG	-	expression tag	UNP Q8WSF8

- Molecule 2 is (1R,5S)-1,2,3,4,5,6-HEXAHYDRO-8H-1,5-METHANOPYRIDO[1,2-A][1,5]DI AZOCIN-8-ONE (three-letter code: C5E) (formula: C<sub>11</sub>H<sub>14</sub>N<sub>2</sub>O).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
2	C	1	Total	C	N	O	0	0
			14	11	2	1		
2	E	1	Total	C	N	O	0	0
			14	11	2	1		

- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	78	Total	O	0	0
			78	78		
3	B	70	Total	O	0	0
			70	70		
3	C	50	Total	O	0	0
			50	50		
3	D	57	Total	O	0	0
			57	57		

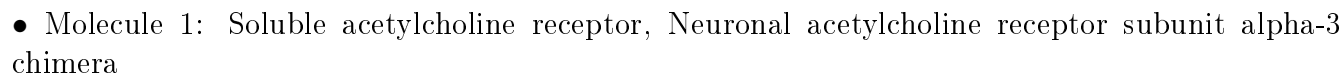
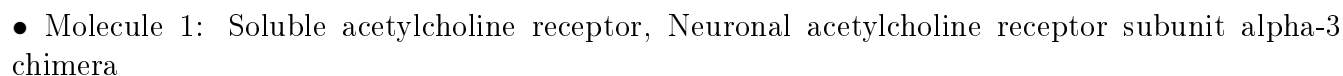
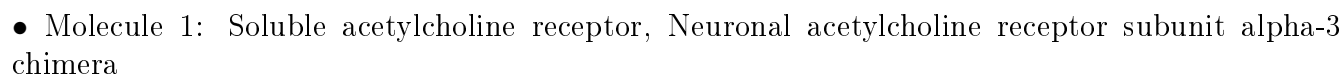
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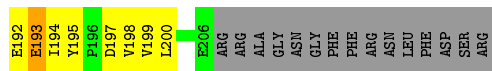
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Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	E	54	Total	O	0	0
			54	54		

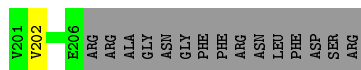
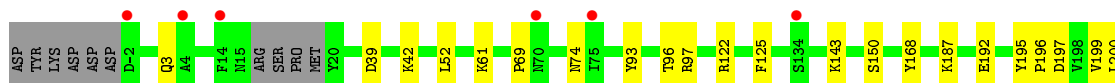
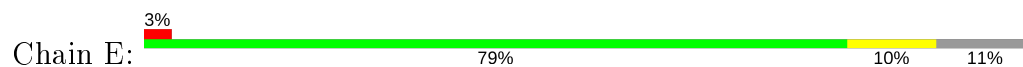


- Molecule 1: Soluble acetylcholine receptor, Neuronal acetylcholine receptor subunit alpha-3 chimera





- Molecule 1: Soluble acetylcholine receptor, Neuronal acetylcholine receptor subunit alpha-3 chimera





## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	68.60 Å 78.08 Å 120.34 Å 90.00° 93.34° 90.00°	Depositor
Resolution (Å)	48.09 – 2.00 48.09 – 2.00	Depositor EDS
% Data completeness (in resolution range)	99.8 (48.09-2.00) 99.9 (48.09-2.00)	Depositor EDS
$R_{merge}$	0.06	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	6.35 (at 2.00 Å)	Xtriage
Refinement program	REFMAC	Depositor
R, $R_{free}$	0.204 , 0.227 0.217 , 0.237	Depositor DCC
$R_{free}$ test set	4293 reflections (5.01%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	27.3	Xtriage
Anisotropy	0.896	Xtriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.34 , 48.1	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.50$ , $\langle L^2 \rangle = 0.33$	Xtriage
Estimated twinning fraction	No twinning to report.	Xtriage
$F_o, F_c$ correlation	0.94	EDS
Total number of atoms	8234	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	30.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 4.27% 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: C5E

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	0.42	0/1625	0.62	0/2221
1	B	0.40	0/1613	0.61	0/2209
1	C	0.38	0/1633	0.60	0/2235
1	D	0.37	0/1604	0.62	1/2195 (0.0%)
1	E	0.40	0/1645	0.62	0/2251
All	All	0.40	0/8120	0.61	1/11111 (0.0%)

There are no bond length outliers.

All (1) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	D	195	TYR	C-N-CD	5.02	138.94	128.40

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	1577	0	1496	13	0
1	B	1565	0	1477	20	0
1	C	1588	0	1491	29	0
1	D	1565	0	1463	25	0
1	E	1602	0	1498	18	0

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Mol	Chain	Non-H	H(model)	H(added)	Clashes	Symm-Clashes
2	C	14	0	14	0	0
2	E	14	0	14	0	0
3	A	78	0	0	2	0
3	B	70	0	0	1	0
3	C	50	0	0	0	0
3	D	57	0	0	2	0
3	E	54	0	0	2	0
All	All	8234	0	7453	95	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 6.

The worst 5 of 95 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:143:LYS:HG2	1:B:199:VAL:HG22	1.48	0.95
1:D:193:GLU:OE2	1:D:193:GLU:N	1.99	0.93
1:D:187:LYS:HB2	1:D:194:ILE:CD1	2.03	0.89
1:B:187:LYS:HD2	1:B:194:ILE:HD11	1.56	0.86
1:C:185:ASP:C	1:C:186:ILE:HD12	1.95	0.86

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	196/230 (85%)	195 (100%)	1 (0%)	0	100	100
1	B	199/230 (86%)	194 (98%)	5 (2%)	0	100	100
1	C	200/230 (87%)	194 (97%)	6 (3%)	0	100	100
1	D	197/230 (86%)	193 (98%)	4 (2%)	0	100	100

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	E	202/230 (88%)	199 (98%)	3 (2%)	0	100	100
All	All	994/1150 (86%)	975 (98%)	19 (2%)	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	175/208 (84%)	175 (100%)	0	100	100
1	B	173/208 (83%)	171 (99%)	2 (1%)	71	76
1	C	176/208 (85%)	174 (99%)	2 (1%)	73	78
1	D	173/208 (83%)	171 (99%)	2 (1%)	71	76
1	E	176/208 (85%)	175 (99%)	1 (1%)	86	90
All	All	873/1040 (84%)	866 (99%)	7 (1%)	81	86

5 of 7 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	C	197	ASP
1	E	61	LYS
1	D	191	CYS
1	B	183	LYS
1	D	193	GLU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (5) such sidechains are listed below:

Mol	Chain	Res	Type
1	B	57	GLN
1	B	162	GLN
1	C	57	GLN
1	D	57	GLN
1	E	70	ASN

### 5.3.3 RNA ⓘ

There are no RNA molecules in this entry.

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

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

## 5.5 Carbohydrates ⓘ

There are no carbohydrates in this entry.

## 5.6 Ligand geometry ⓘ

2 ligands are 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
2	C5E	E	301	-	12,16,16	1.00	1 (8%)	12,23,23	2.91	5 (41%)
2	C5E	C	301	-	12,16,16	1.07	1 (8%)	12,23,23	2.53	4 (33%)

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
2	C5E	E	301	-	-	-	0/3/3/3
2	C5E	C	301	-	-	-	0/3/3/3

All (2) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	E	301	C5E	C-N	2.45	1.41	1.38

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Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	C	301	C5E	C-N	2.45	1.41	1.38

The worst 5 of 9 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	E	301	C5E	C9-N1-C10	6.48	118.81	111.70
2	C	301	C5E	C9-N1-C10	6.36	118.69	111.70
2	E	301	C5E	C5-C6-C10	-5.91	107.08	112.77
2	C	301	C5E	C5-C6-C10	-3.90	109.01	112.77
2	E	301	C5E	C7-C6-C5	2.67	112.39	109.66

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	199/230 (86%)	0.03	4 (2%) 65 63	16, 26, 50, 56	0
1	B	200/230 (86%)	0.12	9 (4%) 33 32	16, 26, 54, 59	0
1	C	202/230 (87%)	0.22	10 (4%) 28 28	17, 30, 54, 62	0
1	D	201/230 (87%)	0.12	4 (1%) 65 63	16, 28, 51, 66	0
1	E	205/230 (89%)	0.15	6 (2%) 51 50	17, 29, 49, 60	0
All	All	1007/1150 (87%)	0.13	33 (3%) 46 45	16, 28, 52, 66	0

The worst 5 of 33 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	152	PHE	3.4
1	C	73	GLY	3.3
1	B	5	ASN	3.2
1	B	70	ASN	3.2
1	C	13	LEU	3.0

### 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 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
2	C5E	E	301	14/14	0.94	0.14	19,20,23,23	0
2	C5E	C	301	14/14	0.94	0.13	22,23,26,27	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.