



# Full wwPDB X-ray Structure Validation Report ⓘ

Nov 2, 2021 – 08:00 PM EDT

PDB ID : 2Z3X  
Title : Structure of a Protein-DNA Complex Essential for DNA Protection in Spore of Bacillus Species  
Authors : Lee, K.S.; Jedrzejewski, M.J.  
Deposited on : 2007-06-08  
Resolution : 2.10 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 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 : 2.23.2  
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) : 2.23.2

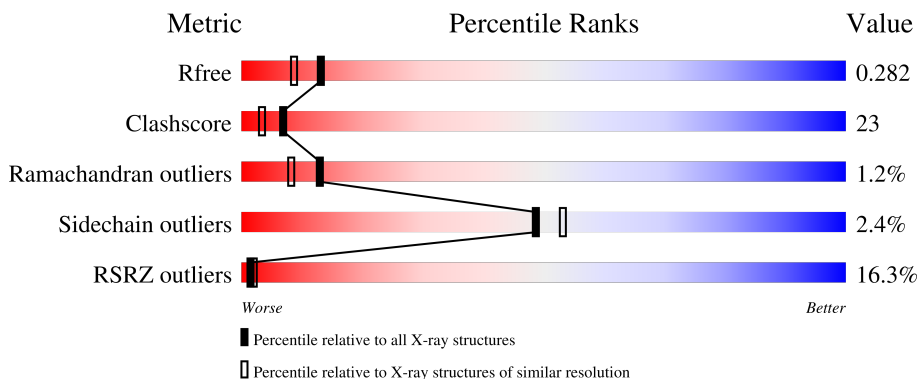
# 1 Overall quality at a glance i

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.10 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	5197 (2.10-2.10)
Clashscore	141614	5710 (2.10-2.10)
Ramachandran outliers	138981	5647 (2.10-2.10)
Sidechain outliers	138945	5648 (2.10-2.10)
RSRZ outliers	127900	5083 (2.10-2.10)

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	D	11	
2	E	11	
3	A	63	
3	B	63	
3	C	63	

## 2 Entry composition

There are 4 unique types of molecules in this entry. The entry contains 1698 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 DNA chain called 5'-D(\*GP\*GP\*GP\*GP\*GP\*GP\*GP\*GP\*GP\*A)-3'.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	P			
1	D	11	238	110	55	63	10	0	0	0

- Molecule 2 is a DNA chain called 5'-D(\*CP\*CP\*CP\*CP\*CP\*CP\*CP\*CP\*CP\*A)-3'.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	P			
2	E	11	208	100	35	63	10	0	0	0

- Molecule 3 is a protein called Small, acid-soluble spore protein C.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
3	A	56	410	253	75	80	2	0	0	0
3	B	56	410	253	75	80	2	0	0	0
3	C	56	410	253	75	80	2	0	0	0

There are 51 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	?	-	MET	deletion	UNP P02958
A	?	-	ALA	deletion	UNP P02958
A	?	-	GLN	deletion	UNP P02958
A	?	-	GLN	deletion	UNP P02958
A	?	-	SER	deletion	UNP P02958
A	?	-	ARG	deletion	UNP P02958
A	?	-	SER	deletion	UNP P02958
A	?	-	ARG	deletion	UNP P02958
A	?	-	SER	deletion	UNP P02958
A	?	-	ASN	deletion	UNP P02958

*Continued on next page...*

*Continued from previous page...*

Chain	Residue	Modelled	Actual	Comment	Reference
A	?	-	ASN	deletion	UNP P02958
A	?	-	ASN	deletion	UNP P02958
A	2	ALA	ASN	engineered mutation	UNP P02958
A	3	LYS	ASP	engineered mutation	UNP P02958
A	62	GLY	-	expression tag	UNP P02958
A	63	GLN	-	expression tag	UNP P02958
A	64	GLN	-	expression tag	UNP P02958
B	?	-	MET	deletion	UNP P02958
B	?	-	ALA	deletion	UNP P02958
B	?	-	GLN	deletion	UNP P02958
B	?	-	GLN	deletion	UNP P02958
B	?	-	SER	deletion	UNP P02958
B	?	-	ARG	deletion	UNP P02958
B	?	-	SER	deletion	UNP P02958
B	?	-	ARG	deletion	UNP P02958
B	?	-	SER	deletion	UNP P02958
B	?	-	ASN	deletion	UNP P02958
B	?	-	ASN	deletion	UNP P02958
B	?	-	ASN	deletion	UNP P02958
B	2	ALA	ASN	engineered mutation	UNP P02958
B	3	LYS	ASP	engineered mutation	UNP P02958
B	62	GLY	-	expression tag	UNP P02958
B	63	GLN	-	expression tag	UNP P02958
B	64	GLN	-	expression tag	UNP P02958
C	?	-	MET	deletion	UNP P02958
C	?	-	ALA	deletion	UNP P02958
C	?	-	GLN	deletion	UNP P02958
C	?	-	GLN	deletion	UNP P02958
C	?	-	SER	deletion	UNP P02958
C	?	-	ARG	deletion	UNP P02958
C	?	-	SER	deletion	UNP P02958
C	?	-	ARG	deletion	UNP P02958
C	?	-	SER	deletion	UNP P02958
C	?	-	ASN	deletion	UNP P02958
C	?	-	ASN	deletion	UNP P02958
C	?	-	ASN	deletion	UNP P02958
C	2	ALA	ASN	engineered mutation	UNP P02958
C	3	LYS	ASP	engineered mutation	UNP P02958
C	62	GLY	-	expression tag	UNP P02958
C	63	GLN	-	expression tag	UNP P02958
C	64	GLN	-	expression tag	UNP P02958

- Molecule 4 is water.

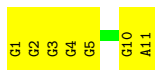
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	D	5	Total O 5 5	0	0
4	E	4	Total O 4 4	0	0
4	A	7	Total O 7 7	0	0
4	B	3	Total O 3 3	0	0
4	C	3	Total O 3 3	0	0

### 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: 5'-D(\*GP\*GP\*GP\*GP\*GP\*GP\*GP\*GP\*GP\*GP\*A)-3'

Chain D:  36% 64%



- Molecule 2: 5'-D(\*CP\*CP\*CP\*CP\*CP\*CP\*CP\*CP\*CP\*CP\*A)-3'

Chain E:  18% 82%



- Molecule 3: Small, acid-soluble spore protein C

Chain A:  6% 60% 29% 11%




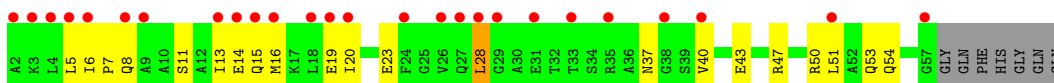
- Molecule 3: Small, acid-soluble spore protein C

Chain B:  2% 59% 29% 11%



- Molecule 3: Small, acid-soluble spore protein C

Chain C:  41% 56% 32% 11%



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 61 2 2	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	86.96Å 86.96Å 144.67Å 90.00° 90.00° 120.00°	Depositor
Resolution (Å)	27.93 – 2.10 40.61 – 2.10	Depositor EDS
% Data completeness (in resolution range)	90.7 (27.93-2.10) 90.7 (40.61-2.10)	Depositor EDS
$R_{merge}$	0.05	Depositor
$R_{sym}$	0.05	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.09 (at 2.10Å)	Xtrriage
Refinement program	CNS 1.1	Depositor
R, $R_{free}$	0.257 , 0.283 0.256 , 0.282	Depositor DCC
$R_{free}$ test set	853 reflections (4.82%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	42.9	Xtrriage
Anisotropy	0.408	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.34 , 51.8	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.31$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.93	EDS
Total number of atoms	1698	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	60.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.41% 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

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	D	0.44	0/270	0.77	0/419
2	E	0.36	0/230	0.83	0/349
3	A	0.35	0/411	0.51	0/550
3	B	0.35	0/411	0.53	0/550
3	C	0.28	0/411	0.44	0/550
All	All	0.35	0/1733	0.61	0/2418

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

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	D	238	0	123	10	1
2	E	208	0	123	13	0
3	A	410	0	429	19	0
3	B	410	0	429	17	0
3	C	410	0	429	26	0
4	A	7	0	0	0	0
4	B	3	0	0	0	0
4	C	3	0	0	0	0
4	D	5	0	0	0	0
4	E	4	0	0	0	0
All	All	1698	0	1533	74	1



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 23.

All (74) 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)
3:A:6:ILE:HD11	3:C:50:ARG:HG3	1.46	0.95
3:A:50:ARG:HG3	3:C:6:ILE:HD11	1.63	0.81
2:E:12:DC:H5''	3:B:5:LEU:HD11	1.67	0.76
3:C:47:ARG:HG2	3:C:50:ARG:HH22	1.52	0.74
3:A:24:PHE:CZ	3:A:43:GLU:HG3	2.24	0.72
2:E:22:DA:H5'	3:C:28:LEU:HD22	1.74	0.68
3:C:47:ARG:HG2	3:C:50:ARG:NH2	2.09	0.68
3:C:20:ILE:HD13	3:C:43:GLU:HB3	1.77	0.66
3:A:6:ILE:H	3:C:53:GLN:HE22	1.45	0.64
1:D:3:DG:H2'	1:D:4:DG:H8	1.62	0.63
3:A:6:ILE:H	3:C:53:GLN:NE2	1.96	0.63
3:A:5:LEU:HD23	3:C:50:ARG:HB2	1.80	0.63
1:D:3:DG:H2''	1:D:4:DG:H5'	1.80	0.62
3:C:7:PRO:HG2	3:C:8:GLN:NE2	2.15	0.61
3:C:13:ILE:HG13	3:C:14:GLU:N	2.15	0.61
2:E:18:DC:H2'	2:E:19:DC:C6	2.38	0.58
3:B:4:LEU:HD11	3:B:13:ILE:HG12	1.85	0.58
3:B:13:ILE:HD12	3:B:14:GLU:N	2.20	0.57
2:E:12:DC:H2'	2:E:13:DC:C6	2.40	0.57
2:E:13:DC:H2''	2:E:14:DC:H5'	1.86	0.57
3:B:24:PHE:CZ	3:B:43:GLU:HG3	2.40	0.57
3:A:13:ILE:HD12	3:A:14:GLU:N	2.20	0.56
3:C:28:LEU:HD21	3:C:40:VAL:HG21	1.87	0.56
2:E:17:DC:H2'	2:E:18:DC:C6	2.41	0.56
3:A:24:PHE:CZ	3:A:43:GLU:CG	2.89	0.55
1:D:3:DG:H2'	1:D:4:DG:C8	2.40	0.55
2:E:22:DA:H5''	3:C:28:LEU:HB3	1.90	0.54
3:A:4:LEU:CD1	3:A:13:ILE:HG12	2.38	0.54
3:A:20:ILE:HD13	3:A:43:GLU:HB3	1.93	0.51
3:C:5:LEU:HB2	3:C:6:ILE:HD12	1.93	0.51
3:B:47:ARG:O	3:B:51:LEU:HG	2.10	0.51
3:B:4:LEU:CD1	3:B:13:ILE:HG12	2.42	0.50
3:C:7:PRO:HG2	3:C:8:GLN:HE22	1.76	0.49
3:B:10:ALA:O	3:B:13:ILE:HG13	2.12	0.49
1:D:3:DG:H2''	1:D:4:DG:C5'	2.42	0.49
3:A:4:LEU:HD11	3:A:13:ILE:HG12	1.94	0.48
2:E:15:DC:O2	3:A:34:SER:HB2	2.13	0.48

*Continued on next page...*

*Continued from previous page...*

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
2:E:19:DC:H2'	2:E:20:DC:C6	2.49	0.48
3:B:6:ILE:HG22	3:B:6:ILE:O	2.14	0.48
3:C:6:ILE:HD12	3:C:6:ILE:N	2.29	0.48
3:C:19:GLU:O	3:C:23:GLU:HG3	2.14	0.47
3:A:45:THR:O	3:A:49:VAL:HG23	2.15	0.47
3:B:3:LYS:HD3	3:B:3:LYS:O	2.15	0.46
3:B:5:LEU:C	3:B:6:ILE:HD12	2.35	0.46
3:C:20:ILE:HA	3:C:23:GLU:OE1	2.16	0.46
3:A:6:ILE:N	3:A:6:ILE:HD12	2.31	0.46
3:C:51:LEU:HA	3:C:54:GLN:NE2	2.31	0.46
1:D:10:DG:H2'	1:D:11:DA:C8	2.51	0.45
1:D:2:DG:H2'	1:D:3:DG:C8	2.51	0.45
1:D:4:DG:H2''	1:D:5:DG:H5'	1.98	0.45
1:D:1:DG:H2''	1:D:2:DG:H5'	1.98	0.45
3:B:54:GLN:C	3:B:56:MET:H	2.20	0.45
3:B:20:ILE:HD13	3:B:43:GLU:HB3	1.98	0.45
3:C:16:MET:O	3:C:20:ILE:HG13	2.17	0.45
2:E:22:DA:H4'	3:C:37:ASN:OD1	2.18	0.44
3:B:24:PHE:CZ	3:B:43:GLU:CG	3.01	0.43
3:A:24:PHE:HB3	3:A:26:VAL:HG13	2.00	0.43
3:B:46:LYS:HE2	3:B:50:ARG:NH2	2.33	0.43
1:D:4:DG:H2'	1:D:5:DG:H8	1.83	0.42
3:A:10:ALA:O	3:A:13:ILE:HG13	2.19	0.42
3:B:3:LYS:HD3	3:B:4:LEU:O	2.18	0.42
3:B:3:LYS:HD3	3:B:3:LYS:C	2.40	0.42
3:C:51:LEU:HD23	3:C:54:GLN:HE22	1.84	0.42
3:A:5:LEU:HB3	3:A:6:ILE:HD12	2.00	0.42
2:E:18:DC:H2'	2:E:19:DC:H6	1.83	0.42
2:E:22:DA:H4'	3:C:37:ASN:CG	2.40	0.42
1:D:4:DG:H2'	1:D:5:DG:C8	2.55	0.42
3:C:50:ARG:HH11	3:C:50:ARG:HG2	1.84	0.42
2:E:17:DC:H2''	2:E:18:DC:H5'	2.02	0.41
3:A:5:LEU:C	3:A:6:ILE:HD12	2.41	0.41
3:B:19:GLU:OE1	3:B:23:GLU:OE1	2.38	0.41
3:C:5:LEU:CB	3:C:6:ILE:HD12	2.51	0.41
3:A:19:GLU:O	3:A:23:GLU:HG3	2.20	0.40
3:C:11:SER:O	3:C:15:GLN:HG2	2.22	0.40

All (1) symmetry-related close contacts are listed below. The label for Atom-2 includes the symmetry operator and encoded unit-cell translations to be applied.

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:D:11:DA:N1	1:D:11:DA:N1[12_566]	2.10	0.10

### 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
3	A	54/63 (86%)	50 (93%)	3 (6%)	1 (2%)	8 3
3	B	54/63 (86%)	50 (93%)	4 (7%)	0	100 100
3	C	54/63 (86%)	49 (91%)	4 (7%)	1 (2%)	8 3
All	All	162/189 (86%)	149 (92%)	11 (7%)	2 (1%)	13 8

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
3	A	56	MET
3	C	28	LEU

#### 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
3	A	42/47 (89%)	41 (98%)	1 (2%)	49 53
3	B	42/47 (89%)	40 (95%)	2 (5%)	25 24
3	C	42/47 (89%)	42 (100%)	0	100 100
All	All	126/141 (89%)	123 (98%)	3 (2%)	49 53

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

Mol	Chain	Res	Type
3	A	28	LEU
3	B	19	GLU
3	B	28	LEU

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

Mol	Chain	Res	Type
3	A	8	GLN
3	A	53	GLN
3	A	54	GLN
3	B	53	GLN
3	B	54	GLN
3	C	8	GLN
3	C	53	GLN
3	C	54	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

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	D	11/11 (100%)	0.26	0 <b>100</b> <b>100</b>	39, 43, 71, 78	0
2	E	11/11 (100%)	0.08	0 <b>100</b> <b>100</b>	38, 45, 74, 84	0
3	A	56/63 (88%)	0.94	4 (7%) <b>16</b> <b>20</b>	36, 52, 92, 106	0
3	B	56/63 (88%)	0.47	1 (1%) <b>68</b> <b>72</b>	34, 48, 76, 86	0
3	C	56/63 (88%)	2.09	26 (46%) <b>0</b> <b>0</b>	57, 88, 99, 100	0
All	All	190/211 (90%)	1.05	31 (16%) <b>1</b> <b>2</b>	34, 57, 95, 106	0

All (31) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
3	A	2	ALA	13.3
3	C	2	ALA	6.4
3	A	57	GLY	5.9
3	C	28	LEU	5.8
3	C	24	PHE	5.4
3	C	13	ILE	5.0
3	C	18	LEU	4.8
3	C	8	GLN	4.7
3	C	5	LEU	4.5
3	B	2	ALA	4.2
3	A	6	ILE	4.2
3	C	20	ILE	4.0
3	C	33	THR	3.9
3	C	3	LYS	3.8
3	A	56	MET	3.6
3	C	9	ALA	3.2
3	C	15	GLN	2.9
3	C	4	LEU	2.5
3	C	51	LEU	2.5
3	C	38	GLY	2.4

*Continued on next page...*

*Continued from previous page...*

Mol	Chain	Res	Type	RSRZ
3	C	31	GLU	2.3
3	C	16	MET	2.3
3	C	57	GLY	2.3
3	C	27	GLN	2.3
3	C	29	GLY	2.3
3	C	6	ILE	2.3
3	C	14	GLU	2.3
3	C	19	GLU	2.2
3	C	35	ARG	2.1
3	C	40	VAL	2.1
3	C	26	VAL	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.