



# Full wwPDB X-ray Structure Validation Report ⓘ

May 17, 2020 – 02:40 pm BST

PDB ID : 4NU3  
Title : Crystal structure of mFfIBP, a capping head region swapped mutant of ice-binding protein  
Authors : Do, H.; Kim, S.J.; Lee, S.G.; Park, H.; Kim, H.J.; Lee, J.H.  
Deposited on : 2013-12-03  
Resolution : 1.40 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.

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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

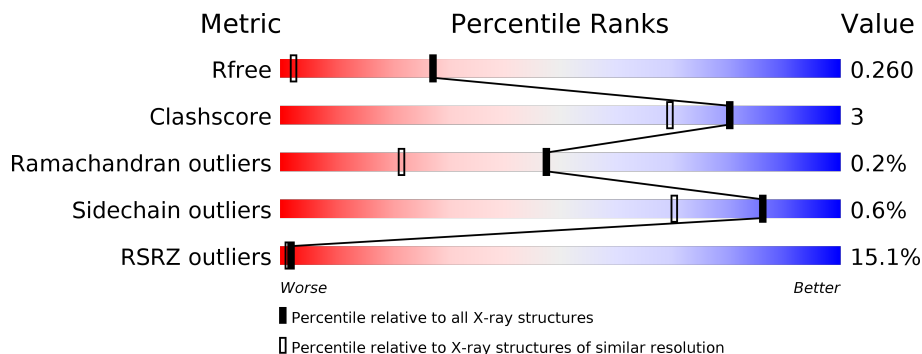
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 1.40 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	1714 (1.40-1.40)
Clashscore	141614	1812 (1.40-1.40)
Ramachandran outliers	138981	1763 (1.40-1.40)
Sidechain outliers	138945	1762 (1.40-1.40)
RSRZ outliers	127900	1674 (1.40-1.40)

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	255	 13% 79% 9% 11%
1	B	255	 14% 82% 7% 12%

## 2 Entry composition [i](#)

There are 4 unique types of molecules in this entry. The entry contains 3932 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 ice-binding protein.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	226	Total 1653	C 1038	N 275	O 334	S 6	0	2	0
1	B	225	Total 1637	C 1029	N 272	O 330	S 6	0	1	0

- Molecule 2 is SULFATE ION (three-letter code: SO4) (formula: O<sub>4</sub>S).



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

- Molecule 3 is SODIUM ION (three-letter code: NA) (formula: Na).

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	B	1	Total Na 1 1	0	0

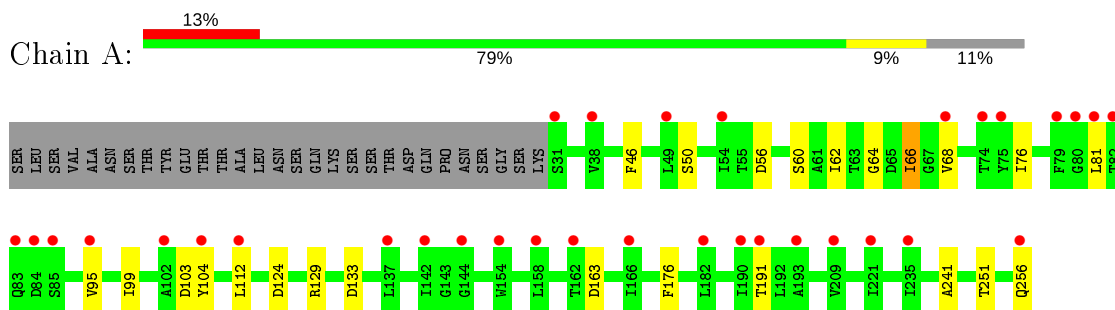
- Molecule 4 is water.

Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	302	Total O 302 302	0	0
4	B	319	Total O 319 319	0	0

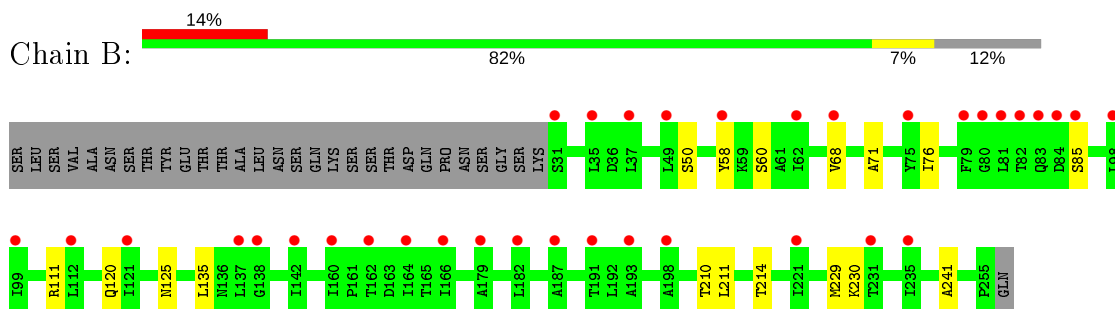
### 3 Residue-property plots [i](#)

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: ice-binding protein



- Molecule 1: ice-binding protein



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 1	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	31.68Å 51.46Å 75.23Å 104.41° 96.85° 97.67°	Depositor
Resolution (Å)	49.11 – 1.40 25.19 – 1.40	Depositor EDS
% Data completeness (in resolution range)	93.2 (49.11-1.40) 93.2 (25.19-1.40)	Depositor EDS
$R_{merge}$	(Not available)	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	5.47 (at 1.40Å)	Xtrriage
Refinement program	REFMAC 5.8.0049	Depositor
R, $R_{free}$	0.223 , 0.250 0.233 , 0.260	Depositor DCC
$R_{free}$ test set	4133 reflections (4.98%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	8.8	Xtrriage
Anisotropy	0.139	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.39 , 47.0	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.51$ , $\langle L^2 \rangle = 0.34$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.92	EDS
Total number of atoms	3932	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	10.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 11.08% 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: NA, SO4

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	1.17	4/1680 (0.2%)	1.18	10/2298 (0.4%)
1	B	1.16	1/1664 (0.1%)	1.14	1/2276 (0.0%)
All	All	1.16	5/3344 (0.1%)	1.16	11/4574 (0.2%)

Chiral center outliers are detected by calculating the chiral volume of a chiral center and verifying if the center is modelled as a planar moiety or with the opposite hand. A planarity outlier is detected by checking planarity of atoms in a peptide group, atoms in a mainchain group or atoms of a sidechain that are expected to be planar.

Mol	Chain	#Chirality outliers	#Planarity outliers
1	A	0	1

All (5) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	60	SER	CB-OG	6.48	1.50	1.42
1	A	64	GLY	N-CA	-5.54	1.37	1.46
1	A	163	ASP	C-O	-5.29	1.13	1.23
1	A	56	ASP	CB-CG	-5.17	1.40	1.51
1	B	60	SER	CA-CB	5.09	1.60	1.52

All (11) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	129	ARG	NE-CZ-NH2	-8.99	115.80	120.30
1	A	124	ASP	CB-CG-OD2	-7.46	111.59	118.30
1	A	56	ASP	CB-CG-OD1	6.62	124.26	118.30
1	A	176	PHE	CB-CG-CD1	6.43	125.30	120.80
1	A	103	ASP	CB-CG-OD1	6.18	123.86	118.30
1	A	133	ASP	CB-CG-OD1	-5.81	113.07	118.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	133	ASP	CB-CG-OD2	5.48	123.24	118.30
1	A	112	LEU	CB-CG-CD1	-5.46	101.73	111.00
1	A	46	PHE	CB-CG-CD2	-5.42	117.01	120.80
1	A	191	THR	CA-CB-CG2	-5.11	105.24	112.40
1	B	135	LEU	CB-CG-CD1	5.09	119.65	111.00

There are no chirality outliers.

All (1) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	251	THR	Mainchain

## 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	1653	0	1651	9	0
1	B	1637	0	1637	9	2
2	A	10	0	0	0	0
2	B	10	0	0	0	0
3	B	1	0	0	0	0
4	A	302	0	0	3	2
4	B	319	0	0	3	4
All	All	3932	0	3288	18	6

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 3.

All (18) 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:66:ILE:CD1	1:A:99:ILE:HG12	1.71	1.19
1:A:66:ILE:HD11	1:A:99:ILE:CG1	1.76	1.14
1:A:104:TYR:N	4:A:634:HOH:O	2.26	0.68
1:B:68[B]:VAL:CG1	1:B:71:ALA:HB3	2.28	0.63

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:68[B]:VAL:HG11	1:B:71:ALA:HB3	1.87	0.56
1:A:66:ILE:HD11	1:A:99:ILE:HG12	0.80	0.56
1:A:95:VAL:HG13	4:A:616:HOH:O	2.07	0.53
1:A:68[B]:VAL:HG22	1:A:76:ILE:HD11	1.91	0.51
1:B:68[A]:VAL:HG12	1:B:76:ILE:HD11	1.97	0.46
1:B:111:ARG:NH1	4:B:414:HOH:O	2.34	0.46
1:B:210:THR:HG23	1:B:230:LYS:NZ	2.32	0.45
1:A:81:LEU:C	1:A:81:LEU:HD23	2.36	0.45
1:B:120:GLN:HB2	4:B:464:HOH:O	2.19	0.43
1:B:125:ASN:ND2	4:B:594:HOH:O	2.51	0.43
1:A:50:SER:HA	1:A:241:ALA:O	2.21	0.41
1:B:50:SER:HA	1:B:241:ALA:O	2.20	0.41
1:A:62:ILE:C	4:A:616:HOH:O	2.58	0.40
1:B:211:LEU:HD12	1:B:229:MET:HG2	2.04	0.40

All (6) 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)
4:B:637:HOH:O	4:B:646:HOH:O[1_455]	1.91	0.29
4:B:669:HOH:O	4:B:701:HOH:O[1_455]	1.93	0.27
1:B:58:TYR:OH	4:A:539:HOH:O[1_655]	1.95	0.25
4:B:683:HOH:O	4:B:698:HOH:O[1_455]	2.00	0.20
4:B:675:HOH:O	4:B:701:HOH:O[1_455]	2.04	0.16
1:B:85:SER:O	4:A:489:HOH:O[1_665]	2.15	0.05

## 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	226/255 (89%)	217 (96%)	9 (4%)	0	<b>100</b> <b>100</b>

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Mol	Chain	Analysed	Favoured	Allowed	Outliers	Percentiles	
1	B	224/255 (88%)	215 (96%)	8 (4%)	1 (0%)	34	12
All	All	450/510 (88%)	432 (96%)	17 (4%)	1 (0%)	47	21

All (1) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	214	THR

### 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	178/202 (88%)	176 (99%)	2 (1%)	73	50
1	B	176/202 (87%)	176 (100%)	0	100	100
All	All	354/404 (88%)	352 (99%)	2 (1%)	86	70

All (2) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	66	ILE
1	A	256	GLN

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](#)

Of 5 ligands modelled in this entry, 1 is monoatomic - leaving 4 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	$\# Z  > 2$
2	SO4	A	301	-	4,4,4	0.58	0	6,6,6	0.43	0
2	SO4	A	302	-	4,4,4	0.64	0	6,6,6	0.70	0
2	SO4	B	302	-	4,4,4	0.28	0	6,6,6	0.63	0
2	SO4	B	301	-	4,4,4	0.86	0	6,6,6	0.55	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

### 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	226/255 (88%)	1.25	33 (14%) 2   2	5, 8, 13, 36	0
1	B	225/255 (88%)	1.27	35 (15%) 2   1	6, 8, 13, 37	0
All	All	451/510 (88%)	1.26	68 (15%) 2   1	5, 8, 13, 37	0

All (68) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	84	ASP	7.6
1	A	256	GLN	6.8
1	A	84	ASP	6.4
1	A	81	LEU	5.8
1	B	31	SER	5.1
1	B	85	SER	4.3
1	B	58	TYR	4.1
1	B	81	LEU	4.1
1	A	31	SER	3.9
1	A	75	TYR	3.4
1	B	82	THR	3.1
1	A	221	ILE	3.0
1	B	160	ILE	3.0
1	B	193	ALA	2.8
1	A	68[A]	VAL	2.8
1	B	98	LEU	2.8
1	B	37	LEU	2.7
1	B	221	ILE	2.7
1	B	187	ALA	2.6
1	B	142	ILE	2.6
1	A	82	THR	2.6
1	A	74	THR	2.5
1	A	49	LEU	2.5
1	B	99	ILE	2.5

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<b>Mol</b>	<b>Chain</b>	<b>Res</b>	<b>Type</b>	<b>RSRZ</b>
1	A	102	ALA	2.5
1	A	182	LEU	2.5
1	A	209	VAL	2.5
1	B	83	GLN	2.4
1	A	85	SER	2.4
1	A	83	GLN	2.4
1	A	235	ILE	2.4
1	B	198	ALA	2.4
1	A	193	ALA	2.3
1	B	179	ALA	2.3
1	B	62	ILE	2.3
1	B	68[A]	VAL	2.3
1	B	191	THR	2.3
1	B	137	LEU	2.3
1	B	182	LEU	2.3
1	A	112	LEU	2.3
1	B	80	GLY	2.3
1	B	231	THR	2.3
1	A	79	PHE	2.2
1	A	190	ILE	2.2
1	B	164	ILE	2.2
1	B	166	ILE	2.2
1	B	138	GLY	2.2
1	B	79	PHE	2.2
1	A	80	GLY	2.2
1	B	112	LEU	2.2
1	B	162	THR	2.2
1	A	38	VAL	2.2
1	A	162	THR	2.2
1	B	35	LEU	2.2
1	A	142	ILE	2.2
1	B	121	ILE	2.2
1	A	104	TYR	2.1
1	A	144	GLY	2.1
1	A	158	LEU	2.1
1	B	49	LEU	2.1
1	A	95	VAL	2.1
1	A	137	LEU	2.1
1	A	54	ILE	2.1
1	A	191	THR	2.1
1	A	154	TRP	2.0
1	B	75	TYR	2.0

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Mol	Chain	Res	Type	RSRZ
1	A	166	ILE	2.0
1	B	235	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 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(Å <sup>2</sup> )	Q < 0.9
2	SO4	A	302	5/5	0.90	0.17	24,27,30,32	0
2	SO4	B	302	5/5	0.92	0.18	21,26,31,33	0
2	SO4	B	301	5/5	0.94	0.20	15,17,23,23	0
2	SO4	A	301	5/5	0.97	0.13	13,15,17,18	0
3	NA	B	303	1/1	0.97	0.07	18,18,18,18	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.