



# Full wwPDB X-ray Structure Validation Report ⓘ

Sep 20, 2023 – 05:13 PM EDT

PDB ID : 5JNV  
Title : Crystal structure of bovine low molecular weight protein tyrosine phosphatase (LMPTP) mutant (W49Y N50E) complexed with HEPES  
Authors : Stanford, S.M.; Aleshin, A.E.; Liddington, R.C.; Bankston, L.; Cadwell, G.; Bottini, N.  
Deposited on : 2016-04-30  
Resolution : 1.60 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>.

---

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 : 2.35.1  
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) : 2.35.1

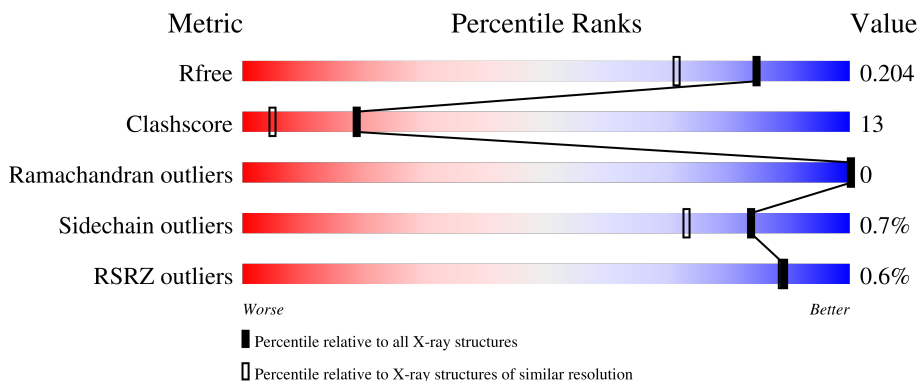
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 1.60 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	3398 (1.60-1.60)
Clashscore	141614	3665 (1.60-1.60)
Ramachandran outliers	138981	3564 (1.60-1.60)
Sidechain outliers	138945	3563 (1.60-1.60)
RSRZ outliers	127900	3321 (1.60-1.60)

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	159	

The following table lists non-polymeric compounds, carbohydrate monomers and non-standard residues in protein, DNA, RNA chains that are outliers for geometric or electron-density-fit criteria:

Mol	Type	Chain	Res	Chirality	Geometry	Clashes	Electron density
3	DMS	A	202	-	X	X	-

## 2 Entry composition i

There are 4 unique types of molecules in this entry. The entry contains 1573 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.

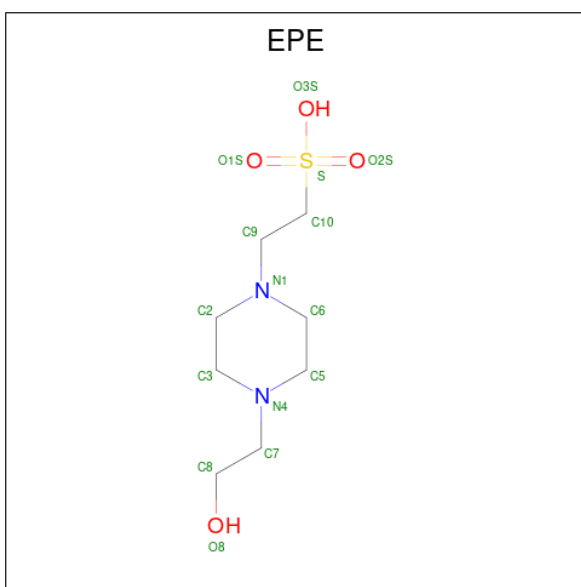
- Molecule 1 is a protein called Low molecular weight phosphotyrosine protein phosphatase.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	154	1325	818	238	260	9	0	11	0

There are 4 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-1	GLY	-	expression tag	UNP P11064
A	0	SER	-	expression tag	UNP P11064
A	49	TYR	TRP	conflict	UNP P11064
A	50	GLU	ASN	conflict	UNP P11064

- Molecule 2 is 4-(2-HYDROXYETHYL)-1-PIPERAZINE ETHANESULFONIC ACID (three-letter code: EPE) (formula: C<sub>8</sub>H<sub>18</sub>N<sub>2</sub>O<sub>4</sub>S).



Mol	Chain	Residues	Atoms					ZeroOcc	AltConf
			Total	C	N	O	S		
2	A	1	15	8	2	4	1	0	0

- Molecule 3 is DIMETHYL SULFOXIDE (three-letter code: DMS) (formula: C<sub>2</sub>H<sub>6</sub>OS).



Mol	Chain	Residues	Atoms				ZeroOcc	AltConf
3	A	1	Total	C	O	S	0	0
			4	2	1	1		
3	A	1	Total	C	O	S	0	0
			4	2	1	1		
3	A	1	Total	C	O	S	0	0
			4	2	1	1		

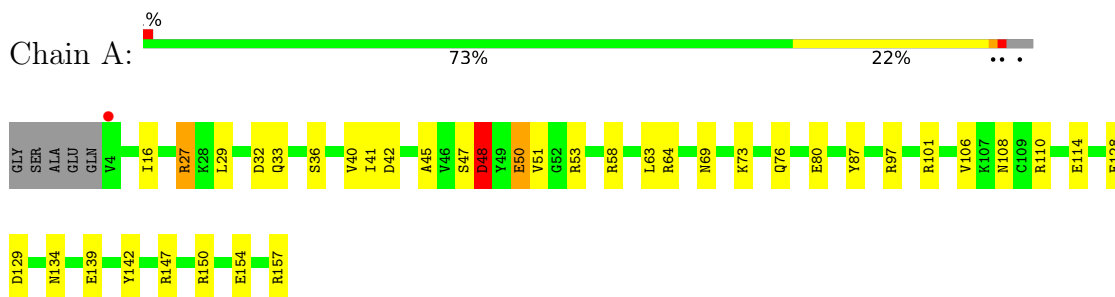
- Molecule 4 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
4	A	221	Total	O	0	0
			221	221		

### 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: Low molecular weight phosphotyrosine protein phosphatase



## 4 Data and refinement statistics

Property	Value	Source
Space group	C 2 2 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	59.94Å 122.94Å 44.89Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	36.25 – 1.60 36.25 – 1.52	Depositor EDS
% Data completeness (in resolution range)	98.4 (36.25-1.60) 95.8 (36.25-1.52)	Depositor EDS
$R_{merge}$	0.08	Depositor
$R_{sym}$	(Not available)	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	1.50 (at 1.52Å)	Xtrriage
Refinement program	REFMAC	Depositor
R, $R_{free}$	0.154 , 0.200 0.162 , 0.204	Depositor DCC
$R_{free}$ test set	1239 reflections (5.01%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	17.1	Xtrriage
Anisotropy	0.180	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.34 , 48.5	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.48$ , $\langle L^2 \rangle = 0.32$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.97	EDS
Total number of atoms	1573	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	21.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.97% 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: DMS, EPE

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	1.79	21/1346 (1.6%)	1.72	31/1817 (1.7%)

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 (21) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	147	ARG	CZ-NH1	11.58	1.48	1.33
1	A	48[A]	ASP	CA-CB	9.86	1.75	1.53
1	A	48[B]	ASP	CA-CB	9.86	1.75	1.53
1	A	48[A]	ASP	CB-CG	-8.02	1.34	1.51
1	A	48[B]	ASP	CB-CG	-8.02	1.34	1.51
1	A	128	GLU	CD-OE1	7.69	1.34	1.25
1	A	128	GLU	CD-OE2	7.51	1.33	1.25
1	A	80[A]	GLU	CD-OE2	7.46	1.33	1.25
1	A	80[B]	GLU	CD-OE2	7.46	1.33	1.25
1	A	36	SER	CB-OG	-7.19	1.32	1.42
1	A	50[A]	GLU	CA-C	6.82	1.70	1.52
1	A	50[B]	GLU	CA-C	6.82	1.70	1.52
1	A	58	ARG	CZ-NH1	6.31	1.41	1.33
1	A	87	TYR	CZ-OH	5.92	1.48	1.37
1	A	154	GLU	CD-OE1	5.70	1.31	1.25
1	A	147	ARG	CZ-NH2	-5.62	1.25	1.33
1	A	154	GLU	CD-OE2	5.31	1.31	1.25
1	A	142	TYR	CG-CD2	-5.12	1.32	1.39

*Continued on next page...*

*Continued from previous page...*

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	139	GLU	CG-CD	-5.06	1.44	1.51
1	A	45	ALA	N-CA	5.03	1.56	1.46
1	A	114	GLU	CD-OE2	-5.00	1.20	1.25

All (31) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
1	A	128	GLU	OE1-CD-OE2	16.43	143.02	123.30
1	A	58	ARG	NE-CZ-NH1	11.57	126.08	120.30
1	A	48[A]	ASP	CB-CG-OD2	10.65	127.88	118.30
1	A	48[B]	ASP	CB-CG-OD2	10.65	127.88	118.30
1	A	147	ARG	NE-CZ-NH2	10.57	125.58	120.30
1	A	101	ARG	NE-CZ-NH1	9.88	125.24	120.30
1	A	157	ARG	NE-CZ-NH1	-8.00	116.30	120.30
1	A	110	ARG	NE-CZ-NH1	7.56	124.08	120.30
1	A	150	ARG	NE-CZ-NH2	-7.53	116.54	120.30
1	A	32	ASP	CB-CG-OD2	-7.19	111.83	118.30
1	A	128	GLU	CG-CD-OE2	-7.08	104.14	118.30
1	A	42	ASP	CB-CG-OD2	-6.99	112.01	118.30
1	A	129	ASP	CB-CG-OD2	-6.95	112.05	118.30
1	A	50[A]	GLU	CA-C-N	6.61	131.75	117.20
1	A	50[B]	GLU	CA-C-N	6.61	131.75	117.20
1	A	101	ARG	NE-CZ-NH2	-6.58	117.01	120.30
1	A	150	ARG	CG-CD-NE	6.49	125.43	111.80
1	A	154	GLU	OE1-CD-OE2	6.38	130.96	123.30
1	A	27	ARG	NE-CZ-NH1	-5.87	117.36	120.30
1	A	150	ARG	NE-CZ-NH1	5.87	123.23	120.30
1	A	48[A]	ASP	CB-CA-C	-5.79	98.82	110.40
1	A	48[B]	ASP	CB-CA-C	-5.79	98.82	110.40
1	A	53	ARG	NE-CZ-NH1	5.76	123.18	120.30
1	A	58	ARG	NE-CZ-NH2	-5.75	117.42	120.30
1	A	42	ASP	CB-CG-OD1	5.31	123.08	118.30
1	A	47[A]	SER	C-N-CA	5.23	134.78	121.70
1	A	47[B]	SER	C-N-CA	5.23	134.78	121.70
1	A	139	GLU	OE1-CD-OE2	-5.19	117.07	123.30
1	A	63	LEU	CB-CG-CD1	-5.18	102.19	111.00
1	A	106	VAL	CG1-CB-CG2	5.10	119.06	110.90
1	A	16	ILE	N-CA-CB	5.06	122.44	110.80

There are no chirality outliers.

All (1) planarity outliers are listed below:



Mol	Chain	Res	Type	Group
1	A	48[A]	ASP	Peptide

## 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	1325	0	1281	32	0
2	A	15	0	16	2	0
3	A	12	0	18	10	0
4	A	221	0	0	9	0
All	All	1573	0	1315	35	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 13.

All (35) 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:48[A]:ASP:CA	1:A:48[A]:ASP:CB	1.75	1.61
1:A:48[A]:ASP:OD2	4:A:303:HOH:O	1.58	1.19
1:A:64[B]:ARG:HH11	1:A:64[B]:ARG:HG2	1.23	1.04
1:A:69[B]:ASN:ND2	4:A:304:HOH:O	1.90	0.98
1:A:48[A]:ASP:CB	1:A:48[A]:ASP:C	2.45	0.83
3:A:204:DMS:C1	4:A:306:HOH:O	2.36	0.74
1:A:64[B]:ARG:HG2	1:A:64[B]:ARG:NH1	2.01	0.71
1:A:50[A]:GLU:OE2	2:A:201:EPE:N4	2.25	0.69
1:A:50[A]:GLU:OE2	2:A:201:EPE:H81	1.94	0.67
1:A:50[B]:GLU:HA	1:A:50[B]:GLU:OE1	1.95	0.67
1:A:27:ARG:HH12	3:A:202:DMS:C2	2.09	0.66
1:A:27:ARG:HH12	3:A:202:DMS:H21	1.61	0.66
3:A:204:DMS:H12	4:A:306:HOH:O	1.92	0.65
1:A:50[B]:GLU:OE1	1:A:50[B]:GLU:CA	2.38	0.64
1:A:64[B]:ARG:HH11	1:A:64[B]:ARG:CG	2.01	0.63
1:A:48[A]:ASP:CB	1:A:48[A]:ASP:N	2.60	0.62
1:A:48[A]:ASP:CA	1:A:48[A]:ASP:CG	2.60	0.59
1:A:64[B]:ARG:NH1	1:A:64[B]:ARG:CG	2.63	0.59
1:A:64[A]:ARG:NH2	4:A:309:HOH:O	2.41	0.53

*Continued on next page...*

Continued from previous page...

Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:41:ILE:H	3:A:202:DMS:C2	2.24	0.51
1:A:73:LYS:NZ	4:A:306:HOH:O	2.28	0.51
1:A:40:VAL:HG13	3:A:202:DMS:C1	2.43	0.48
1:A:41:ILE:H	3:A:202:DMS:H22	1.79	0.48
1:A:48[B]:ASP:O	1:A:51:VAL:CG2	2.63	0.46
1:A:29:LEU:HD11	1:A:33[B]:GLN:NE2	2.31	0.46
1:A:40:VAL:HG13	3:A:202:DMS:H13	1.96	0.46
1:A:97:ARG:HG3	4:A:405:HOH:O	2.15	0.44
3:A:204:DMS:H13	4:A:306:HOH:O	2.13	0.44
1:A:48[B]:ASP:C	1:A:51:VAL:HG23	2.39	0.43
1:A:40:VAL:HA	3:A:202:DMS:H22	2.02	0.42
1:A:48[B]:ASP:HB3	1:A:76:GLN:CD	2.40	0.41
1:A:108:ASN:OD1	1:A:108:ASN:N	2.53	0.41
1:A:48[B]:ASP:O	1:A:51:VAL:HG23	2.21	0.41
1:A:29:LEU:HD11	1:A:33[B]:GLN:HE21	1.86	0.40
1:A:134:ASN:HA	4:A:448:HOH:O	2.20	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	163/159 (102%)	156 (96%)	7 (4%)	0	<b>100</b> <b>100</b>

There are no Ramachandran outliers to report.

### 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	150/142 (106%)	148 (99%)	2 (1%)	69	50

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

Mol	Chain	Res	Type
1	A	48[A]	ASP
1	A	48[B]	ASP

Sometimes 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 monosaccharides in this entry.

## 5.6 Ligand geometry [i](#)

4 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	EPE	A	201	-	15,15,15	1.60	2 (13%)	18,20,20	1.16	2 (11%)

Mol	Type	Chain	Res	Link	Bond lengths			Bond angles		
					Counts	RMSZ	# Z  > 2	Counts	RMSZ	# Z  > 2
3	DMS	A	204	-	3,3,3	0.81	0	3,3,3	0.66	0
3	DMS	A	203	-	3,3,3	0.43	0	3,3,3	0.80	0
3	DMS	A	202	-	3,3,3	2.16	2 (66%)	3,3,3	1.56	1 (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	EPE	A	201	-	-	0/9/19/19	0/1/1/1

All (4) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
2	A	201	EPE	C3-N4	4.27	1.58	1.46
3	A	202	DMS	C2-S	-3.08	1.53	1.75
2	A	201	EPE	C2-N1	2.72	1.54	1.46
3	A	202	DMS	C1-S	-2.06	1.60	1.75

All (3) bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(°)	Ideal(°)
2	A	201	EPE	C2-C3-N4	-2.89	104.71	110.64
3	A	202	DMS	C2-S-C1	2.41	110.83	98.44
2	A	201	EPE	C6-C5-N4	-2.38	105.75	110.64

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

3 monomers are involved in 12 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	201	EPE	2	0
3	A	204	DMS	3	0
3	A	202	DMS	7	0

## 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 [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	154/159 (96%)	-0.18	1 (0%) 89 89	10, 17, 35, 53	0

All (1) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	4	VAL	3.8

### 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](#)

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
3	DMS	A	202	4/4	0.92	0.10	17,27,29,36	0
3	DMS	A	204	4/4	0.92	0.30	26,32,32,35	4
3	DMS	A	203	4/4	0.96	0.11	45,46,46,46	3
2	EPE	A	201	15/15	0.99	0.07	11,16,33,35	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.