



# Full wwPDB X-ray Structure Validation Report ⓘ

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PDB ID : 4NWG  
Title : Crystal structure of the tyrosine phosphatase SHP-2 with E139D mutation  
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Deposited on : 2013-12-06  
Resolution : 2.45 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 : 4.02b-467  
Mogul : 1.8.5 (274361), CSD as541be (2020)  
Xtriage (Phenix) : 1.13  
EDS : 2.36  
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) : 2.36

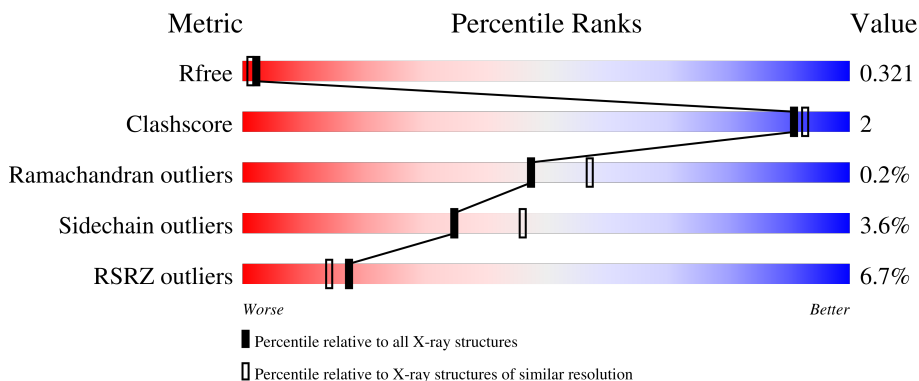
# 1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

*X-RAY DIFFRACTION*

The reported resolution of this entry is 2.45 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	1544 (2.48-2.44)
Clashscore	141614	1613 (2.48-2.44)
Ramachandran outliers	138981	1598 (2.48-2.44)
Sidechain outliers	138945	1598 (2.48-2.44)
RSRZ outliers	127900	1523 (2.48-2.44)

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	539	
1	B	539	

## 2 Entry composition

There are 5 unique types of molecules in this entry. The entry contains 8456 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 Tyrosine-protein phosphatase non-receptor type 11.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
1	A	498	4044	2541	724	760	19	0	2	0
1	B	492	3994	2510	712	753	19	0	1	0

There are 10 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	139	ASP	GLU	engineered mutation	UNP Q06124
A	?	-	GLN	deletion	UNP Q06124
A	?	-	ALA	deletion	UNP Q06124
A	?	-	LEU	deletion	UNP Q06124
A	?	-	LEU	deletion	UNP Q06124
B	139	ASP	GLU	engineered mutation	UNP Q06124
B	?	-	GLN	deletion	UNP Q06124
B	?	-	ALA	deletion	UNP Q06124
B	?	-	LEU	deletion	UNP Q06124
B	?	-	LEU	deletion	UNP Q06124

- Molecule 2 is 1,2-ETHANEDIOL (three-letter code: EDO) (formula: C<sub>2</sub>H<sub>6</sub>O<sub>2</sub>).



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

- Molecule 3 is DI(HYDROXYETHYL)ETHER (three-letter code: PEG) (formula: C<sub>4</sub>H<sub>10</sub>O<sub>3</sub>).



Mol	Chain	Residues	Atoms			ZeroOcc	AltConf
3	A	1	Total	C	O	0	0
			7	4	3		

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



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

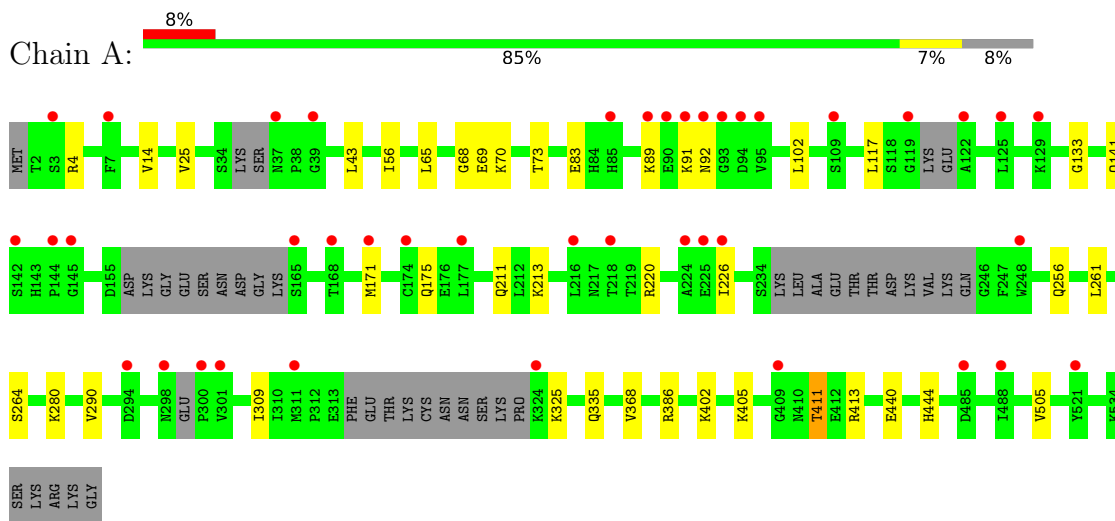
- Molecule 5 is water.

<b>Mol</b>	<b>Chain</b>	<b>Residues</b>	<b>Atoms</b>		<b>ZeroOcc</b>	<b>AltConf</b>
5	A	181	Total 181	O 181	0	0
5	B	181	Total 181	O 181	0	0

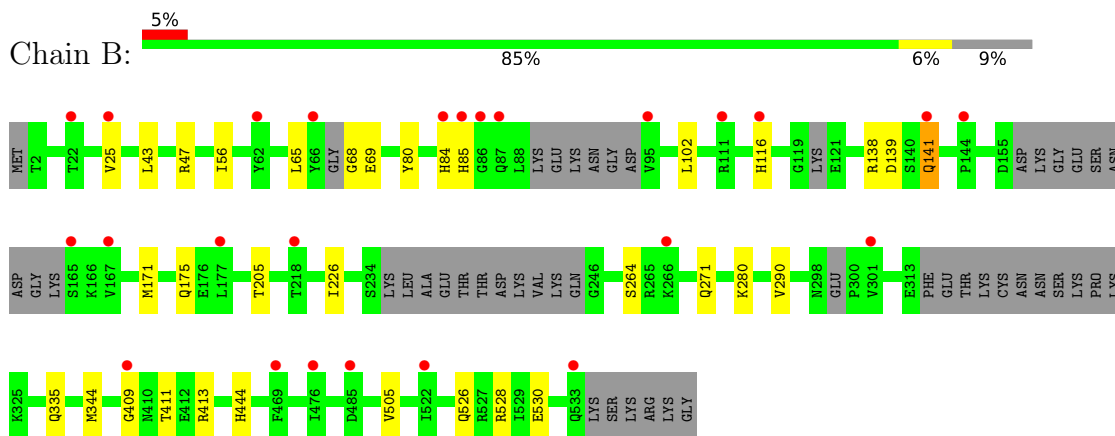
### 3 Residue-property plots [i](#)

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: Tyrosine-protein phosphatase non-receptor type 11



- Molecule 1: Tyrosine-protein phosphatase non-receptor type 11



## 4 Data and refinement statistics

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, $\alpha$ , $\beta$ , $\gamma$	56.32Å 212.42Å 92.16Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	38.64 – 2.45 38.64 – 2.45	Depositor EDS
% Data completeness (in resolution range)	99.9 (38.64-2.45) 99.9 (38.64-2.45)	Depositor EDS
$R_{merge}$	0.11	Depositor
$R_{sym}$	0.07	Depositor
$\langle I/\sigma(I) \rangle$ <sup>1</sup>	2.37 (at 2.45Å)	Xtrriage
Refinement program	BUSTER 2.10.0	Depositor
R, $R_{free}$	0.280 , 0.326 0.275 , 0.321	Depositor DCC
$R_{free}$ test set	1070 reflections (2.58%)	wwPDB-VP
Wilson B-factor (Å <sup>2</sup> )	39.0	Xtrriage
Anisotropy	0.410	Xtrriage
Bulk solvent $k_{sol}$ (e/Å <sup>3</sup> ), $B_{sol}$ (Å <sup>2</sup> )	0.32 , 55.7	EDS
L-test for twinning <sup>2</sup>	$\langle  L  \rangle = 0.55$ , $\langle L^2 \rangle = 0.40$	Xtrriage
Estimated twinning fraction	No twinning to report.	Xtrriage
$F_o, F_c$ correlation	0.93	EDS
Total number of atoms	8456	wwPDB-VP
Average B, all atoms (Å <sup>2</sup> )	48.0	wwPDB-VP

Xtrriage's analysis on translational NCS is as follows: *The analyses of the Patterson function reveals a significant off-origin peak that is 64.09 % of the origin peak, indicating pseudo-translational symmetry. The chance of finding a peak of this or larger height randomly in a structure without pseudo-translational symmetry is equal to 8.7478e-06. The detected translational NCS is most likely also responsible for the elevated intensity ratio.*

<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, PEG, EDO

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	0.36	0/4131	0.58	0/5569
1	B	0.36	0/4074	0.58	0/5495
All	All	0.36	0/8205	0.58	0/11064

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	A	4044	0	3973	18	0
1	B	3994	0	3908	12	0
2	A	28	0	42	5	0
2	B	16	0	24	2	0
3	A	7	0	10	1	0
4	B	5	0	0	0	0
5	A	181	0	0	0	0
5	B	181	0	0	0	0
All	All	8456	0	7957	28	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 (28) 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:405:LYS:H	1:A:411:THR:CG2	2.07	0.67
1:A:73:THR:HG21	2:A:604:EDO:H11	1.78	0.66
1:A:405:LYS:H	1:A:411:THR:HG21	1.68	0.57
1:A:133:GLY:HA3	1:A:213:LYS:HG2	1.88	0.55
1:B:69:GLU:HB3	2:B:605:EDO:H21	1.88	0.55
1:B:280:LYS:HG2	2:B:605:EDO:H22	1.89	0.54
1:A:280:LYS:HG2	2:A:607:EDO:H11	1.91	0.53
1:A:69:GLU:HB3	2:A:607:EDO:H12	1.90	0.53
1:A:25:VAL:HG11	1:B:175:GLN:HB3	1.91	0.52
1:A:175:GLN:HB3	1:B:25:VAL:HG11	1.92	0.51
1:A:65:LEU:HD23	1:A:68:GLY:HA3	1.94	0.50
1:B:65:LEU:HD23	1:B:68:GLY:HA3	1.95	0.49
1:B:409:GLY:C	1:B:411:THR:H	2.15	0.49
1:B:43:LEU:HB2	1:B:56:ILE:HD11	1.95	0.48
1:A:43:LEU:HB2	1:A:56:ILE:HD11	1.95	0.47
1:A:325:LYS:HA	3:A:608:PEG:H41	1.95	0.47
1:A:335:GLN:HG2	1:A:368:VAL:HG11	1.97	0.47
1:B:80:TYR:CE1	1:B:85:HIS:HB2	2.50	0.47
1:A:70:LYS:H	2:A:607:EDO:H12	1.81	0.46
1:A:386[A]:ARG:HB3	1:A:402:LYS:HB2	1.97	0.45
1:B:56:ILE:HG12	1:B:65:LEU:HD12	2.01	0.42
1:A:4:ARG:HD3	1:A:256:GLN:HA	2.00	0.42
1:B:526:GLN:O	1:B:530:GLU:HG2	2.20	0.42
1:A:56:ILE:HG12	1:A:65:LEU:HD12	2.01	0.42
1:B:138:ARG:HH12	1:B:141:GLN:HE22	1.66	0.41
1:A:290:VAL:HG22	1:A:309:ILE:HG13	2.02	0.41
1:B:290:VAL:HG11	1:B:344:MET:HG3	2.03	0.41
1:A:261:LEU:O	2:A:604:EDO:H21	2.21	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	486/539 (90%)	473 (97%)	12 (2%)	1 (0%)	47	57
1	B	477/539 (88%)	462 (97%)	14 (3%)	1 (0%)	47	57
All	All	963/1078 (89%)	935 (97%)	26 (3%)	2 (0%)	47	57

All (2) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	505	VAL
1	B	505	VAL

### 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	445/480 (93%)	428 (96%)	17 (4%)	33	43
1	B	440/480 (92%)	425 (97%)	15 (3%)	37	48
All	All	885/960 (92%)	853 (96%)	32 (4%)	35	46

All (32) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	14	VAL
1	A	83	GLU
1	A	89	LYS
1	A	91	LYS
1	A	92	ASN
1	A	102	LEU
1	A	117	LEU
1	A	141	GLN
1	A	171	MET
1	A	211	GLN
1	A	220	ARG

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Mol	Chain	Res	Type
1	A	226	ILE
1	A	264	SER
1	A	411	THR
1	A	413	ARG
1	A	440	GLU
1	A	444	HIS
1	B	47	ARG
1	B	84	HIS
1	B	102	LEU
1	B	116	HIS
1	B	139	ASP
1	B	141	GLN
1	B	171	MET
1	B	205	THR
1	B	226	ILE
1	B	264	SER
1	B	271	GLN
1	B	335	GLN
1	B	413	ARG
1	B	444	HIS
1	B	528	ARG

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (4) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	257	GLN
1	B	141	GLN
1	B	293	HIS
1	B	526	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](#)

13 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	EDO	A	601	-	3,3,3	0.54	0	2,2,2	0.34	0
2	EDO	B	602	-	3,3,3	0.59	0	2,2,2	0.23	0
2	EDO	A	607	-	3,3,3	0.54	0	2,2,2	0.30	0
2	EDO	A	605	-	3,3,3	0.56	0	2,2,2	0.29	0
3	PEG	A	608	-	6,6,6	0.07	0	5,5,5	0.03	0
2	EDO	B	604	-	3,3,3	0.58	0	2,2,2	0.30	0
2	EDO	A	603	-	3,3,3	0.57	0	2,2,2	0.34	0
2	EDO	B	603	-	3,3,3	0.51	0	2,2,2	0.40	0
2	EDO	A	602	-	3,3,3	0.52	0	2,2,2	0.37	0
2	EDO	B	605	-	3,3,3	0.53	0	2,2,2	0.31	0
2	EDO	A	606	-	3,3,3	0.55	0	2,2,2	0.34	0
4	SO4	B	601	-	4,4,4	0.13	0	6,6,6	0.08	0
2	EDO	A	604	-	3,3,3	0.46	0	2,2,2	0.53	0

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	EDO	A	601	-	-	0/1/1/1	-
2	EDO	B	602	-	-	0/1/1/1	-
2	EDO	A	607	-	-	0/1/1/1	-
2	EDO	A	605	-	-	0/1/1/1	-
3	PEG	A	608	-	-	0/4/4/4	-
2	EDO	B	604	-	-	0/1/1/1	-
2	EDO	A	603	-	-	0/1/1/1	-

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Mol	Type	Chain	Res	Link	Chirals	Torsions	Rings
2	EDO	B	603	-	-	1/1/1/1	-
2	EDO	A	602	-	-	0/1/1/1	-
2	EDO	B	605	-	-	0/1/1/1	-
2	EDO	A	606	-	-	0/1/1/1	-
2	EDO	A	604	-	-	0/1/1/1	-

There are no bond length outliers.

There are no bond angle outliers.

There are no chirality outliers.

All (1) torsion outliers are listed below:

Mol	Chain	Res	Type	Atoms
2	B	603	EDO	O1-C1-C2-O2

There are no ring outliers.

4 monomers are involved in 8 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
2	A	607	EDO	3	0
3	A	608	PEG	1	0
2	B	605	EDO	2	0
2	A	604	EDO	2	0

## 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	498/539 (92%)	0.53	41 (8%) <b>11</b> <b>8</b>	24, 47, 78, 115	0
1	B	492/539 (91%)	0.45	25 (5%) <b>28</b> <b>25</b>	23, 47, 78, 109	0
All	All	990/1078 (91%)	0.49	66 (6%) <b>17</b> <b>14</b>	23, 47, 78, 115	0

All (66) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	A	300	PRO	5.1
1	A	91	LYS	5.0
1	B	85	HIS	4.8
1	A	409	GLY	4.8
1	A	89	LYS	4.2
1	A	125	LEU	4.2
1	A	85	HIS	4.2
1	A	119	GLY	4.1
1	A	224	ALA	3.9
1	A	177	LEU	3.7
1	B	533	GLN	3.5
1	A	90	GLU	3.4
1	A	93	GLY	3.3
1	B	485	ASP	3.2
1	A	122	ALA	3.1
1	B	177	LEU	3.1
1	B	95	VAL	3.0
1	A	92	ASN	3.0
1	A	294	ASP	3.0
1	A	129	LYS	2.9
1	A	301	VAL	2.9
1	A	165	SER	2.8
1	B	111	ARG	2.7
1	A	94	ASP	2.7

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<b>Mol</b>	<b>Chain</b>	<b>Res</b>	<b>Type</b>	<b>RSRZ</b>
1	B	25	VAL	2.7
1	A	109	SER	2.6
1	B	141	GLN	2.6
1	B	165	SER	2.6
1	B	144	PRO	2.6
1	B	84	HIS	2.6
1	A	521	TYR	2.5
1	B	22	THR	2.5
1	A	37	ASN	2.5
1	B	86	GLY	2.5
1	A	324	LYS	2.4
1	A	144	PRO	2.4
1	A	216	LEU	2.4
1	B	409	GLY	2.4
1	B	469	PHE	2.4
1	B	66	TYR	2.4
1	B	116	HIS	2.3
1	B	167	VAL	2.3
1	A	488	ILE	2.3
1	B	218	THR	2.3
1	A	248	TRP	2.3
1	A	39	GLY	2.2
1	A	298	ASN	2.2
1	B	62	TYR	2.2
1	B	476	ILE	2.2
1	B	266	LYS	2.2
1	A	311	MET	2.2
1	A	225	GLU	2.2
1	A	171	MET	2.1
1	A	95	VAL	2.1
1	A	218	THR	2.1
1	B	522	ILE	2.1
1	A	142	SER	2.1
1	B	301	VAL	2.1
1	A	485	ASP	2.1
1	A	3	SER	2.1
1	A	7	PHE	2.1
1	A	174	CYS	2.1
1	A	168	THR	2.0
1	A	226	ILE	2.0
1	A	145	GLY	2.0
1	B	87	GLN	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](#)

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
4	SO4	B	601	5/5	0.60	0.38	107,107,107,107	0
2	EDO	A	604	4/4	0.72	0.36	52,53,53,53	0
3	PEG	A	608	7/7	0.82	0.30	69,69,69,69	0
2	EDO	A	606	4/4	0.83	0.23	65,65,65,65	0
2	EDO	B	603	4/4	0.85	0.34	36,36,37,38	0
2	EDO	A	605	4/4	0.86	0.24	51,51,51,51	0
2	EDO	B	605	4/4	0.88	0.24	41,42,42,43	0
2	EDO	A	601	4/4	0.89	0.24	46,46,47,47	0
2	EDO	A	603	4/4	0.89	0.15	47,48,48,49	0
2	EDO	B	604	4/4	0.89	0.14	48,48,49,49	0
2	EDO	A	607	4/4	0.90	0.29	42,43,43,43	0
2	EDO	B	602	4/4	0.91	0.30	52,52,52,52	0
2	EDO	A	602	4/4	0.92	0.33	44,44,44,44	0

## 6.5 Other polymers [i](#)

There are no such residues in this entry.