



Full wwPDB X-ray Structure Validation Report ⓘ

Jan 23, 2021 – 04:38 PM EST

PDB ID : 2G59
Title : Crystal Structure of the Catalytic Domain of Protein Tyrosine Phosphatase from Homo sapiens
Authors : Kumaran, D.; Swaminathan, S.; Burley, S.K.; New York SGX Research Center for Structural Genomics (NYSGXRC)
Deposited on : 2006-02-22
Resolution : 2.19 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

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
Mogul	:	1.8.5 (274361), CSD as541be (2020)
Xtriage (Phenix)	:	1.13
EDS	:	2.16
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)	:	2.16

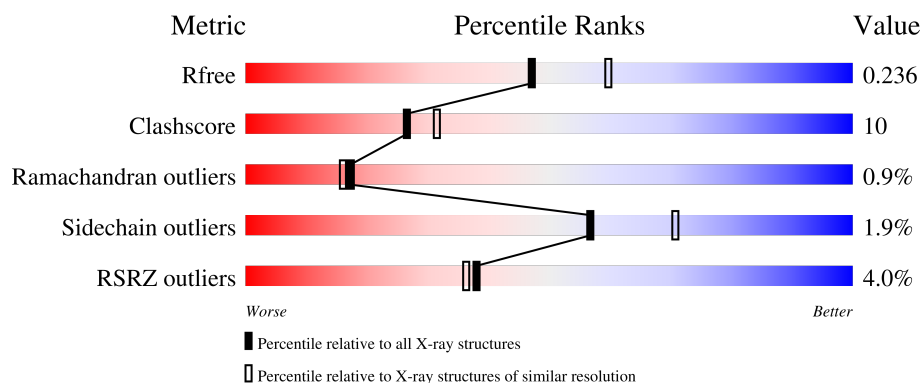
1 Overall quality at a glance

The following experimental techniques were used to determine the structure:

X-RAY DIFFRACTION

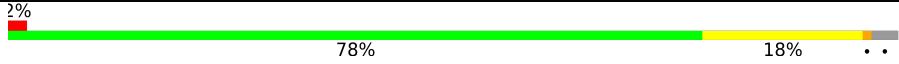

The reported resolution of this entry is 2.19 Å.

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	4898 (2.20-2.20)
Clashscore	141614	5594 (2.20-2.20)
Ramachandran outliers	138981	5503 (2.20-2.20)
Sidechain outliers	138945	5504 (2.20-2.20)
RSRZ outliers	127900	4800 (2.20-2.20)

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 ≥ 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	297	
1	B	297	

2 Entry composition

There are 3 unique types of molecules in this entry. The entry contains 4968 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 Receptor-type tyrosine-protein phosphatase O.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
1	A	287	Total	C	N	O	S	0	0	0
			2364	1501	401	442	20			
1	B	282	Total	C	N	O	S	0	0	0
			2325	1480	397	431	17			

There are 20 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	1	MET	-	expression tag	UNP Q16827
A	2	SER	-	expression tag	UNP Q16827
A	290	GLU	-	expression tag	UNP Q16827
A	291	GLY	-	expression tag	UNP Q16827
A	292	HIS	-	expression tag	UNP Q16827
A	293	HIS	-	expression tag	UNP Q16827
A	294	HIS	-	expression tag	UNP Q16827
A	295	HIS	-	expression tag	UNP Q16827
A	296	HIS	-	expression tag	UNP Q16827
A	297	HIS	-	expression tag	UNP Q16827
B	1	MET	-	expression tag	UNP Q16827
B	2	SER	-	expression tag	UNP Q16827
B	290	GLU	-	expression tag	UNP Q16827
B	291	GLY	-	expression tag	UNP Q16827
B	292	HIS	-	expression tag	UNP Q16827
B	293	HIS	-	expression tag	UNP Q16827
B	294	HIS	-	expression tag	UNP Q16827
B	295	HIS	-	expression tag	UNP Q16827
B	296	HIS	-	expression tag	UNP Q16827
B	297	HIS	-	expression tag	UNP Q16827

- Molecule 2 is PHOSPHATE ION (three-letter code: PO4) (formula: O₄P).



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

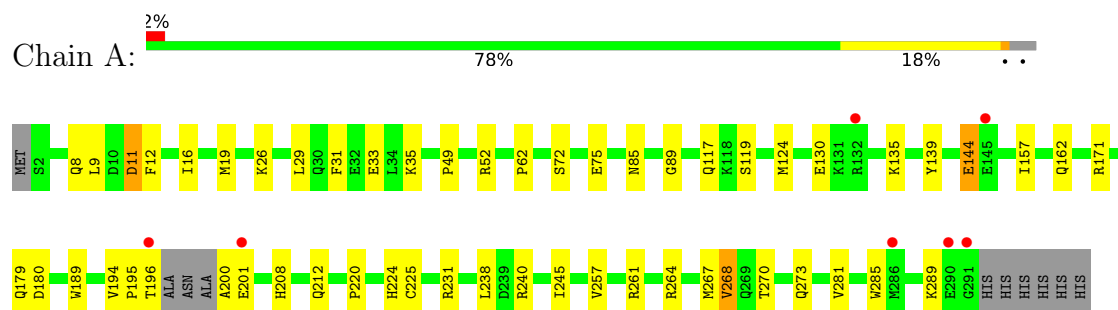
- Molecule 3 is water.

Mol	Chain	Residues	Atoms		ZeroOcc	AltConf
3	A	154	Total	O	0	0
			154	154		
3	B	115	Total	O	0	0
			115	115		

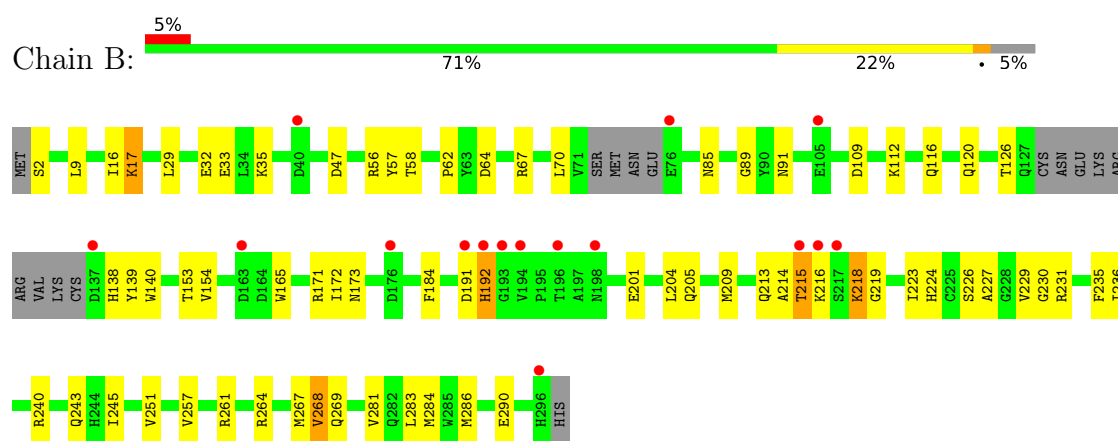
3 Residue-property plots [i](#)

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: Receptor-type tyrosine-protein phosphatase O



• Molecule 1: Receptor-type tyrosine-protein phosphatase O



4 Data and refinement statistics

Property	Value	Source
Space group	P 1 21 1	Depositor
Cell constants a, b, c, α , β , γ	73.87Å 59.72Å 77.00Å 90.00° 102.31° 90.00°	Depositor
Resolution (Å)	31.83 – 2.19 31.83 – 2.18	Depositor EDS
% Data completeness (in resolution range)	96.5 (31.83-2.19) 95.8 (31.83-2.18)	Depositor EDS
R_{merge}	(Not available)	Depositor
R_{sym}	0.10	Depositor
$\langle I/\sigma(I) \rangle$ ¹	2.37 (at 2.18Å)	Xtriage
Refinement program	CNS 1.1	Depositor
R, R_{free}	0.199 , 0.237 0.200 , 0.236	Depositor DCC
R_{free} test set	1623 reflections (4.81%)	wwPDB-VP
Wilson B-factor (Å ²)	19.8	Xtriage
Anisotropy	0.176	Xtriage
Bulk solvent k_{sol} (e/Å ³), B_{sol} (Å ²)	0.35 , 48.8	EDS
L-test for twinning ²	$\langle L \rangle = 0.47$, $\langle L^2 \rangle = 0.30$	Xtriage
Estimated twinning fraction	0.029 for l,-k,h	Xtriage
F_o, F_c correlation	0.93	EDS
Total number of atoms	4968	wwPDB-VP
Average B, all atoms (Å ²)	24.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 5.81% of the height of the origin peak. No significant pseudotranslation is detected.*

¹Intensities estimated from amplitudes.

²Theoretical 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: PO4

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	0.34	0/2422	0.59	0/3276
1	B	0.34	0/2387	0.59	0/3233
All	All	0.34	0/4809	0.59	0/6509

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	2364	0	2278	45	0
1	B	2325	0	2219	50	0
2	A	10	0	0	0	0
3	A	154	0	0	10	0
3	B	115	0	0	2	0
All	All	4968	0	4497	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 10.

All (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:A:85:ASN:HD22	1:A:264:ARG:HH11	1.19	0.88
1:B:85:ASN:HD22	1:B:264:ARG:HH11	1.24	0.85
1:B:91:ASN:HD21	1:B:243:GLN:HE22	1.26	0.80
1:B:153:THR:HB	1:B:173:ASN:OD1	1.84	0.77
1:A:85:ASN:ND2	1:A:264:ARG:HH11	1.84	0.75
1:B:85:ASN:ND2	1:B:264:ARG:HH11	1.85	0.73
1:B:286:MET:O	1:B:290:GLU:HG3	1.89	0.72
1:B:16:ILE:HD12	1:B:17:LYS:N	2.11	0.66
1:B:214:ALA:C	1:B:216:LYS:H	2.00	0.66
1:A:179:GLN:HG3	3:A:473:HOH:O	1.96	0.65
1:B:17:LYS:HA	1:B:17:LYS:NZ	2.12	0.65
1:B:201:GLU:OE2	1:B:283:LEU:HD21	1.97	0.63
1:A:144:GLU:CD	1:A:144:GLU:H	2.02	0.62
1:A:130:GLU:HG3	1:A:135:LYS:HG3	1.81	0.62
1:B:29:LEU:O	1:B:33:GLU:HG3	2.00	0.62
1:A:12:PHE:CE2	1:A:16:ILE:HD11	2.34	0.62
1:A:194:VAL:HG13	1:A:195:PRO:HD2	1.82	0.61
1:A:201:GLU:HG3	3:A:504:HOH:O	2.01	0.59
1:A:200:ALA:N	3:A:425:HOH:O	2.35	0.59
1:A:31:PHE:CD2	1:A:35:LYS:HE3	2.37	0.59
1:B:9:LEU:HD21	1:B:251:VAL:HG13	1.83	0.58
1:A:11:ASP:HA	3:A:544:HOH:O	2.04	0.58
1:A:139:TYR:OH	1:A:224:HIS:HE1	1.87	0.57
1:B:184:PHE:HZ	1:B:213:GLN:HG3	1.71	0.56
1:B:214:ALA:O	1:B:216:LYS:N	2.38	0.56
1:B:17:LYS:HA	1:B:17:LYS:HZ2	1.70	0.55
1:B:139:TYR:OH	1:B:224:HIS:HE1	1.91	0.54
1:B:154:VAL:HG22	1:B:172:ILE:HG13	1.89	0.53
1:A:208:HIS:O	1:A:212:GLN:HG2	2.08	0.53
1:A:52:ARG:HG2	3:A:467:HOH:O	2.08	0.53
1:B:64:ASP:O	1:B:67:ARG:HG2	2.09	0.53
1:A:257:VAL:O	1:A:261:ARG:HG3	2.09	0.52
1:B:204:LEU:HD12	1:B:283:LEU:HD23	1.92	0.52
1:B:120:GLN:OE1	1:B:218:LYS:HB2	2.11	0.51
1:B:32:GLU:HA	1:B:35:LYS:HD3	1.92	0.51
1:B:56:ARG:HD2	1:B:226:SER:O	2.10	0.51
1:A:119:SER:O	1:A:179:GLN:NE2	2.44	0.51
1:A:171:ARG:HG2	1:A:180:ASP:OD1	2.11	0.51
1:B:126:THR:HG22	1:B:231:ARG:NH1	2.27	0.50
1:A:49:PRO:HA	1:A:52:ARG:HG3	1.93	0.49
1:B:192:HIS:ND1	1:B:192:HIS:N	2.59	0.49
1:B:230:GLY:HA2	1:B:269:GLN:H	1.77	0.49

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:223:ILE:HD13	1:B:235:PHE:CD2	2.47	0.49
1:A:19:MET:HA	1:A:26:LYS:HB2	1.94	0.49
1:A:245:ILE:HD11	1:A:281:VAL:HG13	1.93	0.49
1:A:270:THR:OG1	1:A:273:GLN:HG3	2.12	0.49
1:B:223:ILE:HD12	1:B:236:ILE:CG1	2.42	0.49
1:B:2:SER:HB3	3:B:348:HOH:O	2.11	0.49
1:A:9:LEU:HD13	1:A:285:TRP:CE3	2.48	0.48
1:B:172:ILE:N	1:B:172:ILE:HD12	2.28	0.48
1:A:162:GLN:NE2	3:A:491:HOH:O	2.47	0.48
1:B:214:ALA:C	1:B:216:LYS:N	2.66	0.48
1:B:224:HIS:HD2	3:B:314:HOH:O	1.95	0.48
1:A:224:HIS:HD2	1:A:225:CYS:O	1.97	0.47
1:B:62:PRO:HB3	1:B:85:ASN:HD21	1.79	0.47
1:B:16:ILE:C	1:B:16:ILE:HD12	2.35	0.47
1:B:62:PRO:CB	1:B:85:ASN:HD21	2.28	0.47
1:A:157:ILE:HG13	1:A:171:ARG:HH11	1.80	0.47
1:A:285:TRP:O	1:A:289:LYS:HG3	2.15	0.46
1:B:245:ILE:HD11	1:B:281:VAL:HG13	1.97	0.46
1:A:267:MET:O	1:A:268:VAL:HB	2.15	0.45
1:B:229:VAL:HG23	1:B:230:GLY:N	2.32	0.45
1:A:212:GLN:HB2	3:A:440:HOH:O	2.17	0.45
1:B:223:ILE:HD12	1:B:236:ILE:HG12	1.99	0.44
1:B:267:MET:O	1:B:268:VAL:HB	2.17	0.44
1:B:264:ARG:O	1:B:267:MET:HG2	2.18	0.43
1:A:157:ILE:HG13	1:A:171:ARG:HG3	2.00	0.43
1:A:89:GLY:HA2	1:A:240:ARG:HD2	2.00	0.43
1:A:72:SER:HB3	1:A:75:GLU:HB2	2.00	0.42
1:B:165:TRP:HH2	1:B:205:GLN:HG2	1.83	0.42
1:A:124:MET:HG3	1:A:224:HIS:NE2	2.35	0.42
1:A:31:PHE:O	1:A:35:LYS:HG3	2.20	0.42
1:B:171:ARG:C	1:B:172:ILE:HD12	2.40	0.42
1:A:194:VAL:HG12	1:A:196:THR:H	1.85	0.42
1:A:72:SER:HB2	3:A:509:HOH:O	2.19	0.42
1:A:195:PRO:O	1:A:196:THR:C	2.57	0.41
1:A:26:LYS:HG3	3:A:403:HOH:O	2.20	0.41
1:B:215:THR:C	1:B:216:LYS:HG3	2.40	0.41
1:B:257:VAL:O	1:B:261:ARG:HG2	2.19	0.41
1:A:85:ASN:ND2	1:A:264:ARG:NH1	2.61	0.41
1:B:62:PRO:HA	1:B:85:ASN:HD21	1.86	0.41
1:B:245:ILE:HD12	1:B:284:MET:SD	2.60	0.41
1:A:29:LEU:O	1:A:33:GLU:HG3	2.20	0.41

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:B:57:TYR:CE2	1:B:227:ALA:HB2	2.56	0.41
1:B:138:HIS:CD2	1:B:140:TRP:O	2.74	0.41
1:A:189:TRP:CE2	1:A:231:ARG:HG2	2.56	0.41
1:B:112:LYS:O	1:B:116:GLN:HG3	2.20	0.41
1:B:89:GLY:HA2	1:B:240:ARG:HD2	2.03	0.40
1:A:117:GLN:O	1:A:220:PRO:HD2	2.22	0.40
1:A:144:GLU:HB2	3:A:457:HOH:O	2.20	0.40
1:A:62:PRO:HA	1:A:85:ASN:HD21	1.86	0.40
1:B:70:LEU:HD11	1:B:109:ASP:HB3	2.04	0.40
1:A:261:ARG:HA	1:A:264:ARG:O	2.22	0.40
1:A:62:PRO:CB	1:A:85:ASN:HD21	2.34	0.40
1:B:138:HIS:HD2	1:B:140:TRP:O	2.04	0.40

There are no symmetry-related clashes.

5.3 Torsion angles ⓘ

5.3.1 Protein backbone ⓘ

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	283/297 (95%)	270 (95%)	12 (4%)	1 (0%)	34	37
1	B	276/297 (93%)	265 (96%)	7 (2%)	4 (1%)	11	8
All	All	559/594 (94%)	535 (96%)	19 (3%)	5 (1%)	17	16

All (5) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	B	215	THR
1	B	218	LYS
1	A	268	VAL
1	B	268	VAL
1	B	219	GLY

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	260/268 (97%)	256 (98%)	4 (2%)	65	78
1	B	253/268 (94%)	247 (98%)	6 (2%)	49	62
All	All	513/536 (96%)	503 (98%)	10 (2%)	57	71

All (10) residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
1	A	8	GLN
1	A	11	ASP
1	A	144	GLU
1	A	238	LEU
1	B	17	LYS
1	B	47	ASP
1	B	58	THR
1	B	191	ASP
1	B	192	HIS
1	B	209	MET

Sometimes sidechains can be flipped to improve hydrogen bonding and reduce clashes. All (6) such sidechains are listed below:

Mol	Chain	Res	Type
1	A	85	ASN
1	A	224	HIS
1	B	85	ASN
1	B	91	ASN
1	B	138	HIS
1	B	224	HIS

5.3.3 RNA ⓘ

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](#)

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	PO4	A	400	-	4,4,4	1.58	0	6,6,6	0.47	0
2	PO4	A	401	-	4,4,4	1.57	0	6,6,6	0.43	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, 95th 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 ²)	Q<0.9
1	A	287/297 (96%)	0.22	7 (2%) 59 56	11, 20, 40, 59	0
1	B	282/297 (94%)	0.38	16 (5%) 23 22	10, 23, 45, 60	0
All	All	569/594 (95%)	0.30	23 (4%) 38 36	10, 21, 43, 60	0

All (23) RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	B	194	VAL	5.7
1	A	291	GLY	4.5
1	B	76	GLU	4.2
1	B	193	GLY	3.6
1	B	176	ASP	3.4
1	A	196	THR	3.3
1	B	216	LYS	3.2
1	B	215	THR	3.0
1	B	192	HIS	3.0
1	B	191	ASP	2.9
1	A	286	MET	2.9
1	A	145	GLU	2.9
1	A	290	GLU	2.6
1	B	137	ASP	2.4
1	B	296	HIS	2.4
1	A	201	GLU	2.4
1	B	196	THR	2.4
1	B	105	GLU	2.4
1	B	198	ASN	2.3
1	B	163	ASP	2.3
1	A	132	ARG	2.1
1	B	217	SER	2.1
1	B	40	ASP	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, 95th 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(\AA^2)	Q<0.9
2	PO4	A	401	5/5	0.96	0.13	45,46,46,46	0
2	PO4	A	400	5/5	0.98	0.10	14,15,20,22	0

6.5 Other polymers [i](#)

There are no such residues in this entry.