wwPDB X-ray Structure Validation Summary Report (i)

Feb 1, 2016 – 02:33 PM GMT

PDB ID	:	3ZUV
Title	:	Crystal structure of a designed selected Ankyrin Repeat protein in complex with the phosphorylated MAP kinase ERK2
Authors	:	Kummer, L.; Mittl, P.R.; Pluckthun, A.
Deposited on	:	2011-07-20
Resolution	:	2.72 Å(reported)

This is a wwPDB X-ray Structure Validation Summary Report for a publicly released PDB entry.
We welcome your comments at validation@mail.wwpdb.org
A user guide is available at
http://wwpdb.org/validation/2016/XrayValidationReportHelp
with specific help available everywhere you see the (i) symbol.

The following versions of software and data (see references (1)) were used in the production of this report:

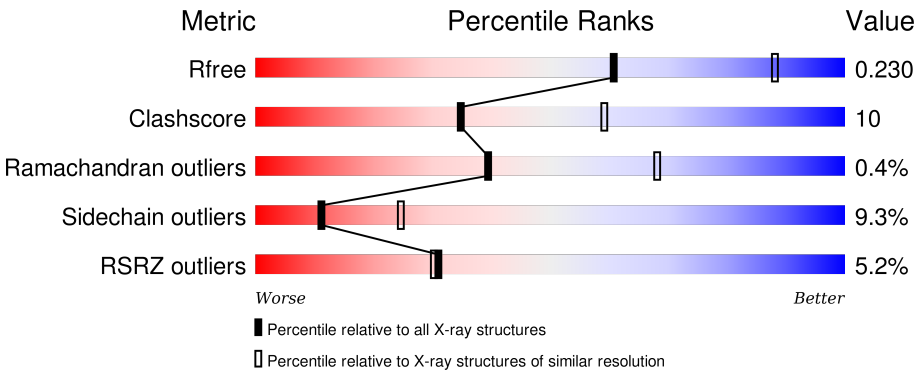
MolProbity	:	4.02b-467
Mogul	:	1.7 (RC4), CSD as536be (2015)
Xtriage (Phenix)	:	1.9-1692
EDS	:	rb-20026688
Percentile statistics	:	20151230.v01 (using entries in the PDB archive December 30th 2015)
Refmac	:	5.8.0135
CCP4	:	6.5.0
Ideal geometry (proteins)	:	Engh & Huber (2001)
Ideal geometry (DNA, RNA)	:	Parkinson et al. (1996)
Validation Pipeline (wwPDB-VP)	:	trunk26865

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 2.72 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}	91344	2439 (2.74-2.70)
Clashscore	102246	2771 (2.74-2.70)
Ramachandran outliers	100387	2726 (2.74-2.70)
Sidechain outliers	100360	2727 (2.74-2.70)
RSRZ outliers	91569	2443 (2.74-2.70)

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 >=3, 2, 1 and 0 types of geometric quality criteria. 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 <=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	364	76% 19% • •
1	C	364	3% 73% 22% • •
2	B	136	71% 14% • 10%
2	D	136	28% 64% 22% • 10%

2 Entry composition (i)

There are 4 unique types of molecules in this entry. The entry contains 8003 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 MITOGEN-ACTIVATED PROTEIN KINASE 1.

Mol	Chain	Residues	Atoms						ZeroOcc	AltConf	Trace
			Total	C	N	O	P	S			
1	A	359	2953	1886	510	539	2	16	0	3	0
1	C	359	2979	1900	515	546	2	16	0	6	0

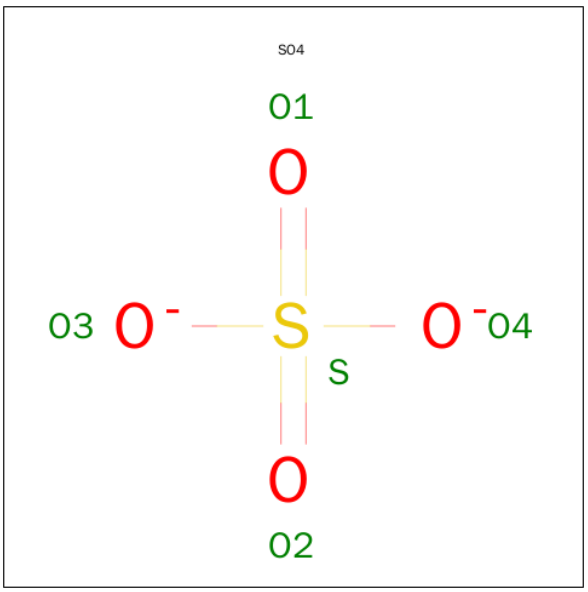
There are 16 discrepancies between the modelled and reference sequences:

Chain	Residue	Modelled	Actual	Comment	Reference
A	-5	HIS	-	EXPRESSION TAG	UNP P63086
A	-4	HIS	-	EXPRESSION TAG	UNP P63086
A	-3	HIS	-	EXPRESSION TAG	UNP P63086
A	-2	HIS	-	EXPRESSION TAG	UNP P63086
A	-1	HIS	-	EXPRESSION TAG	UNP P63086
A	0	HIS	-	EXPRESSION TAG	UNP P63086
A	1	ALA	-	EXPRESSION TAG	UNP P63086
A	2	MET	-	EXPRESSION TAG	UNP P63086
C	-5	HIS	-	EXPRESSION TAG	UNP P63086
C	-4	HIS	-	EXPRESSION TAG	UNP P63086
C	-3	HIS	-	EXPRESSION TAG	UNP P63086
C	-2	HIS	-	EXPRESSION TAG	UNP P63086
C	-1	HIS	-	EXPRESSION TAG	UNP P63086
C	0	HIS	-	EXPRESSION TAG	UNP P63086
C	1	ALA	-	EXPRESSION TAG	UNP P63086
C	2	MET	-	EXPRESSION TAG	UNP P63086

- Molecule 2 is a protein called DESIGNED ANKYRIN REPEAT PROTEIN.

Mol	Chain	Residues	Atoms					ZeroOcc	AltConf	Trace
			Total	C	N	O	S			
2	B	122	939	587	161	190	1	0	2	0
2	D	122	919	575	158	185	1	0	0	0

- Molecule 3 is SULFATE ION (three-letter code: SO4) (formula: O_4S).



Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
3	A	1	Total O S 5 4 1	0	0
3	C	1	Total O S 5 4 1	0	0

- Molecule 4 is water.

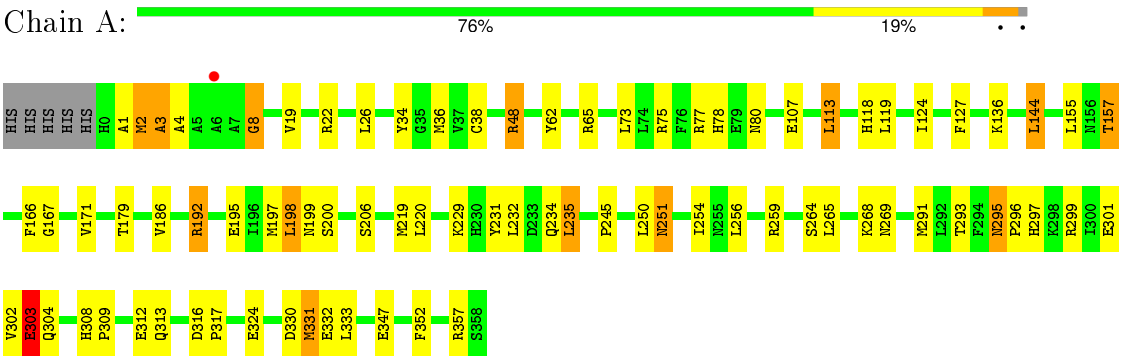
Mol	Chain	Residues	Atoms	ZeroOcc	AltConf
4	A	119	Total O 119 119	0	0
4	B	12	Total O 12 12	0	0
4	C	69	Total O 69 69	0	0
4	D	3	Total O 3 3	0	0

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 errors 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.

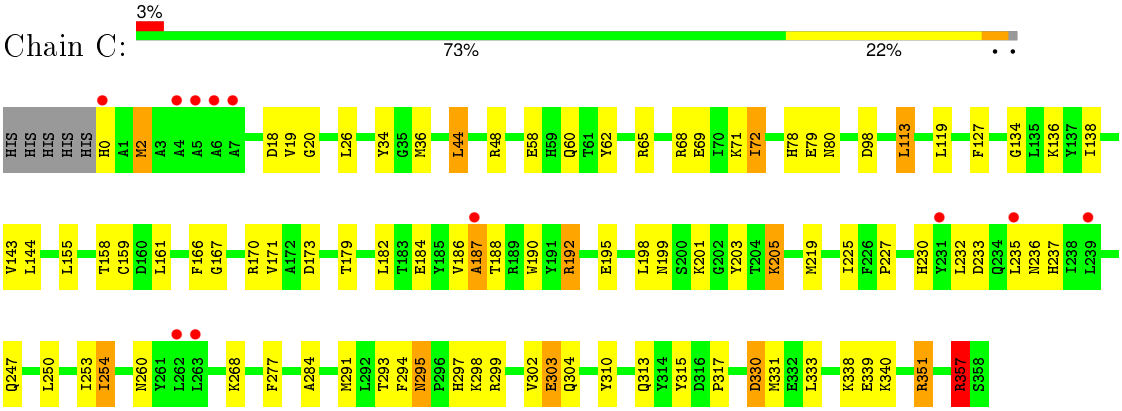
- Molecule 1: MITOGEN-ACTIVATED PROTEIN KINASE 1

Chain A:



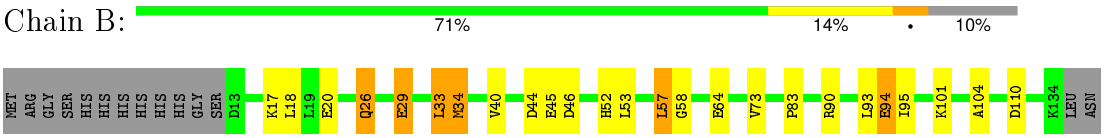
- Molecule 1: MITOGEN-ACTIVATED PROTEIN KINASE 1

Chain C:



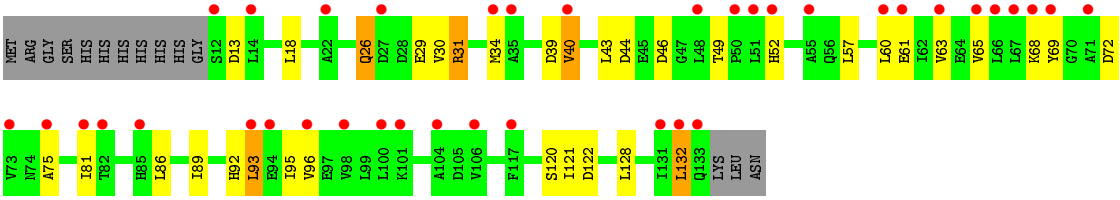
- Molecule 2: DESIGNED ANKYRIN REPEAT PROTEIN

Chain B:



- Molecule 2: DESIGNED ANKYRIN REPEAT PROTEIN

Chain D:


MET ARG GLY SER HIS HIS HIS HIS HIS HIS GLY S12 D13 L14 L18 A22 Q26 D27 D28 E29 V30 R31 M34 A35 D39 V40 L43 D44 E45 D46 G47 L48 T49 P50 L51 H52 A55 Q56 L57 L60 E61 I62 V63 E64 V65 L66 L67 K68 Y69 G70 A71 D72
V73 N74 A75 I81 T82 H85 I86 I89 H92 I93 E94 I95 V96 E97 V98 I99 I100 K101 A104 D105 V106 F117 S120 I121 D122 L128 I131 L132 Q133 LYS LEU ASN

4 Data and refinement statistics (i)

Property	Value	Source
Space group	P 21 21 21	Depositor
Cell constants a, b, c, α, β, γ	113.67Å 150.45Å 104.97Å 90.00° 90.00° 90.00°	Depositor
Resolution (Å)	77.12 – 2.72 77.12 – 2.72	Depositor EDS
% Data completeness (in resolution range)	100.0 (77.12-2.72) 98.1 (77.12-2.72)	Depositor EDS
R_{merge}	0.05	Depositor
R_{sym}	(Not available)	Depositor
$< I/\sigma(I) >$ [1]	2.43 (at 2.73Å)	Xtriage
Refinement program	REFMAC 5.5.0109	Depositor
R, R_{free}	0.176 , 0.230 0.176 , 0.230	Depositor DCC
R_{free} test set	2411 reflections (5.26%)	DCC
Wilson B-factor (Å^2)	56.4	Xtriage
Anisotropy	0.048	Xtriage
Bulk solvent k_{sol}(e/Å^3), B_{sol}(Å^2)	0.31 , 48.0	EDS
Estimated twinning fraction	No twinning to report.	Xtriage
L-test for twinning[2]	$< \|L\| > = 0.49$, $< L^2 > = 0.32$	Xtriage
Outliers	0 of 48265 reflections	Xtriage
F_o,F_c correlation	0.95	EDS
Total number of atoms	8003	wwPDB-VP
Average B, all atoms (Å^2)	60.0	wwPDB-VP

Xtriage's analysis on translational NCS is as follows: *The largest off-origin peak in the Patterson function is 3.81% of the height of the origin peak. No significant pseudotranslation is detected.*

[1] Intensities estimated from amplitudes.

[2] Theoretical values of $< |L| >$, $< L^2 >$ for acentric reflections are 0.5, 0.375 respectively for untwinned datasets, and 0.333, 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: TPO, SO4, PTR

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	1.03	5/2995 (0.2%)	1.01	7/4054 (0.2%)
1	C	0.93	4/3021 (0.1%)	0.97	5/4089 (0.1%)
2	B	0.90	1/949 (0.1%)	0.94	2/1284 (0.2%)
2	D	0.68	0/929	0.79	0/1258
All	All	0.94	10/7894 (0.1%)	0.96	14/10685 (0.1%)

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	2
1	C	0	1
All	All	0	3

The worst 5 of 10 bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	347	GLU	CG-CD	8.00	1.64	1.51
1	A	303	GLU	CB-CG	7.09	1.65	1.52
1	A	303	GLU	CG-CD	6.46	1.61	1.51
1	C	303	GLU	CG-CD	5.81	1.60	1.51
2	B	20	GLU	CG-CD	5.61	1.60	1.51

The worst 5 of 14 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	A	192	ARG	NE-CZ-NH2	-10.66	114.97	120.30
1	A	357	ARG	NE-CZ-NH2	-9.13	115.74	120.30

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Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	C	357	ARG	NE-CZ-NH2	-8.72	115.94	120.30
1	C	351	ARG	NE-CZ-NH1	8.11	124.36	120.30
1	A	357	ARG	NE-CZ-NH1	7.84	124.22	120.30

There are no chirality outliers.

All (3) planarity outliers are listed below:

Mol	Chain	Res	Type	Group
1	A	19	VAL	Peptide
1	A	8	GLY	Peptide
1	C	253	ILE	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	2953	0	2936	61	0
1	C	2979	0	2953	62	0
2	B	939	0	925	16	0
2	D	919	0	909	19	0
3	A	5	0	0	1	0
3	C	5	0	0	1	0
4	A	119	0	0	9	0
4	B	12	0	0	0	0
4	C	69	0	0	2	0
4	D	3	0	0	0	0
All	All	8003	0	7723	154	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.

The worst 5 of 154 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:107:GLU:OE2	1:A:157:THR:HG23	1.28	1.23

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Atom-1	Atom-2	Interatomic distance (Å)	Clash overlap (Å)
1:A:107:GLU:OE2	1:A:157:THR:CG2	2.05	1.03
1:C:313[B]:GLN:HE21	1:C:313[B]:GLN:H	1.08	0.98
1:C:313[B]:GLN:H	1:C:313[B]:GLN:NE2	1.62	0.95
1:A:78:HIS:HD2	1:A:80:ASN:H	1.09	0.95

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	358/364 (98%)	338 (94%)	17 (5%)	3 (1%)	24	50
1	C	361/364 (99%)	331 (92%)	29 (8%)	1 (0%)	46	74
2	B	122/136 (90%)	116 (95%)	6 (5%)	0	100	100
2	D	120/136 (88%)	110 (92%)	10 (8%)	0	100	100
All	All	961/1000 (96%)	895 (93%)	62 (6%)	4 (0%)	39	68

All (4) Ramachandran outliers are listed below:

Mol	Chain	Res	Type
1	A	2	MET
1	A	8	GLY
1	A	3	ALA
1	C	187	ALA

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	320/322 (99%)	295 (92%)	25 (8%)	16 34
1	C	323/322 (100%)	295 (91%)	28 (9%)	13 28
2	B	97/107 (91%)	85 (88%)	12 (12%)	6 13
2	D	95/107 (89%)	81 (85%)	14 (15%)	4 9
All	All	835/858 (97%)	756 (90%)	79 (10%)	11 24

5 of 79 residues with a non-rotameric sidechain are listed below:

Mol	Chain	Res	Type
2	B	94[B]	GLU
1	C	72	ILE
2	D	63	VAL
2	B	101	LYS
1	C	44	LEU

Some sidechains can be flipped to improve hydrogen bonding and reduce clashes. 5 of 15 such sidechains are listed below:

Mol	Chain	Res	Type
1	C	15	GLN
1	C	78	HIS
1	C	295	ASN
2	B	123	ASN
1	C	269	ASN

5.3.3 RNA (i)

There are no RNA molecules in this entry.

5.4 Non-standard residues in protein, DNA, RNA chains (i)

4 non-standard protein/DNA/RNA residues 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	$\#\|Z\| > 2$
1	TPO	A	183	1	8,10,11	1.00	0	7,14,16	1.62	3 (42%)
1	PTR	A	185	1	14,16,17	1.94	2 (14%)	18,22,24	1.09	1 (5%)
1	TPO	C	183	1	8,10,11	0.94	0	7,14,16	1.70	2 (28%)
1	PTR	C	185	1	14,16,17	1.99	1 (7%)	18,22,24	1.20	2 (11%)

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
1	TPO	A	183	1	-	0/8/11/13	0/0/0/0
1	PTR	A	185	1	-	0/9/11/13	0/1/1/1
1	TPO	C	183	1	-	0/8/11/13	0/0/0/0
1	PTR	C	185	1	-	0/9/11/13	0/1/1/1

All (3) bond length outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(Å)	Ideal(Å)
1	A	185	PTR	OH-CZ	-6.39	1.25	1.40
1	C	185	PTR	OH-CZ	-6.15	1.25	1.40
1	A	185	PTR	CE2-CZ	2.15	1.43	1.38

The worst 5 of 8 bond angle outliers are listed below:

Mol	Chain	Res	Type	Atoms	Z	Observed(^{o})	Ideal(^{o})
1	C	183	TPO	OG1-P-O1P	-2.77	100.19	107.11
1	C	185	PTR	O-C-CA	-2.60	118.72	125.49
1	A	183	TPO	OG1-P-O1P	-2.50	100.87	107.11
1	A	183	TPO	O-C-CA	-2.01	120.13	125.44
1	A	183	TPO	O3P-P-O1P	2.03	117.11	110.58

There are no chirality outliers.

There are no torsion outliers.

There are no ring outliers.

No monomer is involved in short contacts.

5.5 Carbohydrates (i)

There are no carbohydrates 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	$\#\|Z\| > 2$
3	SO4	A	1359	-	4,4,4	0.49	0	6,6,6	0.46	0
3	SO4	C	1359	-	4,4,4	0.24	0	6,6,6	0.52	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
3	SO4	A	1359	-	-	0/0/0/0	0/0/0/0
3	SO4	C	1359	-	-	0/0/0/0	0/0/0/0

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.

2 monomers are involved in 2 short contacts:

Mol	Chain	Res	Type	Clashes	Symm-Clashes
3	A	1359	SO4	1	0
3	C	1359	SO4	1	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 (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, 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	357/364 (98%)	-0.15	1 (0%) 94 95	27, 46, 75, 139	0
1	C	357/364 (98%)	0.05	11 (3%) 52 53	32, 55, 88, 139	0
2	B	122/136 (89%)	-0.14	0 100 100	39, 62, 83, 97	0
2	D	122/136 (89%)	1.52	38 (31%) 1 0	66, 98, 135, 152	0
All	All	958/1000 (95%)	0.14	50 (5%) 31 30	27, 56, 112, 152	0

The worst 5 of 50 RSRZ outliers are listed below:

Mol	Chain	Res	Type	RSRZ
1	C	7	ALA	5.7
2	D	63	VAL	4.4
2	D	12	SER	4.2
1	C	0	HIS	4.0
2	D	60	LEU	4.0

6.2 Non-standard residues in protein, DNA, RNA chains (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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. 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	LLDF	B-factors(Å^2)	Q<0.9
1	PTR	A	185	16/17	0.99	0.17	-	34,39,43,44	0
1	TPO	C	183	11/12	0.99	0.15	-	41,45,48,49	0
1	PTR	C	185	16/17	0.98	0.13	-	45,48,53,53	0
1	TPO	A	183	11/12	0.99	0.16	-	35,43,46,49	0

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. LLDF column lists the quality of electron density of the group with respect to its neighbouring residues in protein, DNA or RNA chains. 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	LLDF	B-factors(Å^2)	Q<0.9
3	SO4	A	1359	5/5	0.93	0.23	-	95,96,98,99	0
3	SO4	C	1359	5/5	0.88	0.20	-	106,106,107,109	0

6.5 Other polymers (i)

There are no such residues in this entry.